Publication 527-02-1-628

REPORT OF NAVLOGSIP SUB-WORKING GROUP 14.3

RELIABILITY AND MAINTAINABILITY DATA-FEEDBACK SYSTEMS

30 JUNE 1966

Prepared for
U. S. NAVAL APPLIED SCIENCE LABORATORY
BROOKLYN, NEW YORK
under Contract N00140 66 C0151

ARINC RESEARCH CORPORATION

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: 527-02-1-628
2. GOVT ACCESSION NO.:
3. RECIPIENT'S CATALOG NUMBER:

(6) 4. TITLE (and Subtitle): RELIABILITY AND MAINTAINABILITY DATA-FEEDBACK SYSTEMS.

5. TYPE OF REPORT & PERIOD COVERED:

(14) 6. PERFORMING ORG. REPORT NUMBER: 527-02-1-628

7. AUTHOR(s): Not Listed

(15) 8. CONTRACT OR GRANT NUMBER(s): N00140-66-C0151 (new) K

9. PERFORMING ORGANIZATION NAME AND ADDRESS:
ARINC Research Corporation
2551 Riva Road
Annapolis, Maryland 21401

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:

11. CONTROLLING OFFICE NAME AND ADDRESS:
U.S. NAVAL APPLIED SCIENCE LABORATORY
Brooklyn, New York

(11) 12. REPORT DATE: 30 June 1966

13. NUMBER OF PAGES: 114

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):
U.S. NAVAL APPIED SCIENCE LABORATORY
Brooklyn, New York

(12) 186p.

15. SECURITY CLASS. (of this report): UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report):
UNCLASSIFIED /UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report):

18. SUPPLEMENTARY NOTES:

19. KEY WORDS (Continue on reverse side if necessary and identify by block number):

20. ABSTRACT (Continue on reverse side if necessary and identify by block number):

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

400 247

UNCLASSIFIED (2B)
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(4)

Report of NAVLOGSIP SUB-WORKING GROUP 14.3

(6) RELIABILITY AND MAINTAINABILITY
DATA-FEEDBACK SYSTEMS.

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Annapolis, Maryland 21401

Publication 527-02-1-628

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FOREWORD

This report is the result of a study performed by NAVLOGSIP Sub-working Group (SWG) 14.3. The study concerned reliability and maintainability needs from data-feedback systems currently in use by military and industrial organizations, and the requirements for an expanded system. The sub-working group, operating under the Action Officer, NAVLOGSIP Objective Number 14, consisted of the following representatives:

Mr. J. Sacks, Head, Dependability Engineering,
NAVSEC, Chairman

Dr. R. Lundegard, ONR

Mr. E. E. Sheehan, NAVMAT

Mr. D. Manahan, NATC-MEAB, ST-37A

ARINC Research Corporation acted as consultant to the sub-working group.

SUMMARY

1. General

This report from NAVLOGSIP Sub-Working Group 14.3 describes a study of maintenance data systems presently being used by the Navy, other military branches, and manufacturers, and recommends data-elements for collection in an improved Navy system. The Navy data-collection systems reviewed included both expiring and continuing systems. Data elements required for shipyard collection, as proposed by AEFF Code 1820, Philadelphia Naval Shipyard, have been integrated with those recommended by the NAVLOGSIP sub-working group. Minimum data-collection requirements were established for the three phases of an equipment's life cycle: (1) research and development, (2) design and preproduction, and (3) operation. The data elements recommended for collection are classified as:

(1) Bookkeeping elements

(2) Time, Cycle, and Date elements

(3) Technical Support elements

The elements are listed in Table S-1, along with definitions and major justifications for inclusion. Each data element listed is required in one or more computations whose results provide management with valuable decision-making tools.

2. Conclusions

(1) Data elements now being collected by manufacturers could be utilized more effectively in the existing Navy data-collection systems.

(2) There are wide variations in the types of data being collected by manufacturers. This seems to be the result of nonuniformity in the data-collection requirements placed on the manufacturers by Navy project managers.

(3) A reliability program conducted in compliance with MIL-STD-785 and SECNAVINST 3900.36 will supply information that is adequate for Navy management use in a particular project. However, these documents do not require that the information be passed on to external activities, such as Navy central data banks. Instructions for maintainability programs are even less comprehensive.

(4) Standardization of computational procedures by FARADA and the University of Pennsylvania's Monitor Data System would increase the usefulness of the data being collected; standardization of computational procedures in accordance with the general effectiveness model (GEM) developed by the Naval Applied Science Laboratory would be appropriate.

TABLE S-1

RECOMMENDED DATA-ELEMENT REQUIREMENTS
FOR RELIABILITY AND MAINTAINABILITY DATA-FEEDBACK SYSTEM

Data Element	Life-Cycle Phase* 1	2	3	Definition	Major Justification
Bookkeeping					
Reporting Activity	▨	▨	▨	Identification of the data source	To identify the location of the equipment when the event occurred.
Equipment Identification Code Number (EIC), or Federal Stock Number (FSN) or Work Unit Code (WUC)		▨	▨	The equipment identification code number from catalog	To provide equipment or part identification
Name of Equipment	▨	▨	▨	Identification of the equipment at the highest assembly level	To maintain record of malfunctions by equipment identification
Manufacturer's Model Number for the Equipment	▨	▨	▨	Manufacturer's model number for the equipment	To identify equipment or system by model number
Serial Number of Equipment	▨	▨	▨	Manufacturer's serial number assigned to the equipment	To maintain record of malfunctions by equipment serial number
Equipment Manufacturer's Name or Code	▨	▨	▨	Identification of manufacturer of equipment	To monitor manufacturer's performance
Contract Number	▨	▨		Identification of contract under which the equipment was produced	To assist in monitoring contractor compliance with equipment specifications and warranties
Name of Failed Assembly		▨	▨	Identification of the assembly in which the malfunction occurred	To maintain record of malfunctions by assembly designation
Manufacturer of Failed Assembly		▨	▨	Identification of manufacturer of assembly in which failure occurred	To monitor manufacturer's performance and identify problems
Drawing Number or Federal Stock Number of Failed Assembly		▨	▨	Manufacturer's drawing number or FSN of assembly in which failure occurred	To identify the particular assembly design
Name of Failed Part	▨	▨	▨	Identification of the failed part	To maintain a record of malfunctions by part identification
Manufacturer's Part Number or Federal Stock Number for Failed Part	▨	▨	▨	Manufacturer's Part number or failed stock number for the failed part	To identify the failure by part number
Serial Number of Failed Part (if applicable)	▨	▨	▨	Manufacturer's serial number of the failed part	To maintain record of malfunctions by part serial number
Manufacturer of Failed Part	▨	▨	▨	Identification of manufacturer of failed part	To monitor manufacturer's performance and identify problems
Drawing Reference Designator or Circuit Symbol of Failed Part		▨	▨	Manufacturer's drawing reference, circuit symbol, or other identification of the application of the failed part	To analyze application stresses
Manufacturer of Replacement Part	▨	▨	▨	Identification of manufacturer of replacement part	To maintain configuration control

* Phase 1 - Research and Development Phase
Phase 2 - Design and Preproduction Phase
Phase 3 - Operation Phase

(continued)

TABLE S-1 (continued)

Data Element	Life-Cycle Phase 1	2	3	Definition	Major Justification
Serial Number (where applicable) of Replacement Part	▨	▨	▨	Serial number of replacement part	To maintain configuration control
Technical Rating of Maintenance Personnel			▨	Navy technical rating of personnel who performed the maintenance	To monitor the adequacy of technical-personnel assignments
Applicable Technical Manuals			▨	Identification (including revision number) of manuals, drawings, instructions, etc. used by maintenance personnel	To monitor adequacy and availability of technical support documents
Name of Test Facility	▨	▨		Identification of the facility conducting the test if this is different from the reporting activity	To identify location of equipment when failure occurred
Time, Cycle, and Date					
Date of Report	▨	▨	▨	Calendar date of report	To monitor efficiency of failure-reporting system
Date of Malfunction		▨	▨	Calendar date malfunctioned was observed	To monitor sequence of failure and to trace environmental conditions
Operating Time on the Specific Equipment when Malfunction Occurred	▨	▨	▨	Operating Time on the Specific Equipment when Malfunction Occurred	To compute equipment failure distributions with time
Number of cycles, starts, landings etc. on the malfunctioning equipment when the malfunction occurred (if applicable)	▨	▨	▨	Number of cycles, starts, landings etc. on the malfunctioning equipment when the malfunction occurred	To compute equipment failure distributions with cycles
Accumulated Operating Time on all equipments (Periodic Reporting)	▨	▨	▨	Accumulated Operating time on all equipments	To compute failure rates
Accumulated cycles, starts landings etc. on all equipments. (Periodic Reporting)	▨	▨	▨	Accumulated cycles, starts landings etc, on all equipments	To compute failure rates
Date Maintenance Started		▨	▨	Calendar date maintenance started	To compute equipment MTTR and availability
Date Maintenance Ended		▨	▨	Calendar date maintenance ended	To compute equipment MTTR and availability
Clock Time Maintenance Started		▨	▨	Time maintenance started	To compute equipment MTTR and availability
Clock Time Maintenance Ended		▨	▨	Time maintenance ended	To compute equipment MTTR and availability
Active Maintenance Man-Hours		▨	▨	Active repair time for preventive and corrective maintenance actions	To compute Maintenance Support Index of the equipment and cost of repair
Man-Hours to Diagnose Malfunction		▨	†	Total number of man-hours required to identify the functional problem area	To assess ease of problem identification
Man-Hours to Gain Access to Malfunctioned Part		▨	†	Total number of man-hours required to gain access to malfunctional part	To assess ease of physical access to the problem area
Man-Hours to Repair, Replace, or Adjust malfunctioned Part		▨	†	Total number of man-hours required to repair, replace, or adjust the malfunctioned part	To assess ease of repair

† Collected during initial period of operation (length of period depends on equipment classification).

(continued)

TABLE S-1 (continued)

Data Element	Life-Cycle Phase 1	2	3	Definition	Major Justification
Technical Support					
Environment when Malfunction Occurred		▨	▨	Identification of natural and functional environment when equipment failed	To analyze the effect of environment on reliability
Equipment Operation at Time of Malfunction		▨	▨	Equipment operation when failure occurred. (Full load, flank speed, cruise, idle, static, energized, radiating, off, etc.	To analyze stresses present when failure occurred
Effect of Malfunction on Equipment Operation		▨	▨	Description of equipment performance after failure occurred	To assess equipment capability in a degraded mode
Symptoms of Malfunction		▨	▨	Description of abnormal manifestations at time of malfunction	To assist in problem identification and verification
Malfunction Verified	▨	▨	▨	Verification that the part failed	To ensure accuracy in reliability computations
Cause of Malfunction	▨	▨		Comments or suggestions from the responsible technician	To assist in problem identification
Condition of Failed Part (How Malfunctioned)		▨	▨	Description of failed part such as broken, bent, burned, etc.	To assist in problem identification
Primary or Secondary Failure		▨		Information on whether this was a primary failure or one caused by failure of another part	Required to evaluate failure cause, mode, to censor failures, and to assess failure effect
Disposition of Replaced Part			▨	Description of what was done with the failed part after removal, such as repaired, returned to contractor, scrapped	To provide a record of final disposition for cost and failure analysis
Is a Follow-Up Report Required?			▨	No, if repair has been completed; Yes, if repair has not been completed or if analysis of failed parts is to be performed	To alert analyst if additional maintenance or data is involved
Type of Test Being Conducted	▨	▨		Name of test, with description and purpose	To identify the controlled operating conditions
Number of Equipments Under Test		▨		Total number of equipments of the same type under the same test	To compute probability of success (total population required)

(5) Standard instructions to manufacturers, laboratories, and test facilities on the collection of data elements during controlled tests would facilitate the collection of accurate data.

(6) The data-element nomenclatures and definitions used in the Navy, other military, and manufacturer's data-feedback systems are varied and incompatible.

(7) The existing data-feedback systems are not adequate in the areas of reliability, maintainability, and availability for effective equipment evaluation nor to allow project managers to comply properly with SECNAV Instruction 3900.36.

3. Recommendations

The following recommendations cover requirements for achieving an integrated Navy data-feedback system that will provide Naval management personnel with adequate information in the areas of equipment reliability, maintainability, and availability. The recommendations are based on conclusions made by NAVLOGSIPS SWG 14.3 during its investigation of military and manufacturer data-collection systems.

3.1 Recommendations for Data-Element Reporting

The reliability and maintainability data-elements specified in Table S-1 are the minimum required by Navy management personnel to perform their functional assignments. It is recommended that these reporting requirements be implemented as follows:

(1) Navy Project Offices that have responsibility for prototype-equipment development should be instructed to collect from manufacturers, laboratories, and test facilities the data elements specified for collection during the research and development phase. These data should be transmitted to FARADA and the University of Pennsylvania's Monitor Data System.

(2) COMOPTEVFOR and Navy Project Offices that have responsibility for evaluating the preproduction equipments (including modifications to operational equipments) should be instructed to collect the data specified for collection during the design and preproduction phase. The data should be transmitted to the data banks.

(3) A program plan that will result in a cost-effective data-feedback system for the operation phase should be developed and implemented. (The plan should incorporate the recommendations given later in this section.) In the interim, data collection in the operation phase

should continue collecting the following trial elements that have been added to the MDCS (ships).

- Equipment operating time
- Part failure modes
- Part failure cause
- Effect of failure on operational status
- Equipment downtime
- Failed part source (manufacturer)
- Serial number of failed assembly, modules, and LDA
- Active repair time, including calendar time and man-hours
- Rates and specialties of maintenance technicians

(4) A military standard which classifies equipments by complexity, sensitivity (to handling, maintenance, or operation), technical sophistication, and life expectancy should be developed as a basis for establishing the periods of time after which general reporting may be substituted for detailed reporting. Detailed reporting is defined as the collection and transmittal of all the data elements specified. General reporting is defined as the collection and transmittal of only a selected group of the specified data elements; basic failure reports, periodic operating-time, and other data necessary to compute equipment reliability and availability would be submitted, while elements concerned with environment, symptoms, effect on equipment, detailed maintenance times, and others would not be collected.

The standard should include a collection procedure, based on equipment classification, similar to the following:

(a) During the research and development phase and the design and preproduction phase, detailed data reporting will be required on a continuing basis.

(b) Detailed reporting for a new or a newly modified operational equipment will be conducted for a period based on the equipment classification or until the equipment stabilizes. General reporting requirements will then continue for a period of six to twelve months, depending on the equipments' classification.

(c) On a yearly or bi-yearly cycle, depending on the equipment classification, detailed reporting will be resumed for a short period.

This selective reporting procedure would provide sufficient information to monitor equipment effectiveness and wear-out trends, reduce the cost of operating the data-feedback system and reduce the reporting burden.

(5) The collection procedure included in recommendation 4 might be modified (with some risk to accurate decision making) by requiring that the periodic shift to detailed reporting (item C in the procedure) be made on only a selected sample of equipments; sampling would be based on the equipment classifications.

(6) A tabular form for data reporting should be developed for use in the operation phase. The form's design should be based on the effective use of electronic data processing machines and computers as to relieve Fleet and aviation personnel of the task of performing computations. Additionally, the form should provide for reporting of equipment operating time on a monthly basis.

Table S-2 shows the items that should be requested on the form. Each item's general location on the form is shown, but no attempt has been made to establish an effective layout or design.

(7) Part-replacement data should be reported at the intermediate, tender, shop, and depot maintenance levels. To support Navy cost-effectiveness evaluations, the following minimum information is required:

(a) Maintenance man-hours at the assembly or subassembly level

(b) EIC and serial number

(c) Part replacement identification, including LDA, part number, and reference designation or circuit symbol identification

(d) How malfunctioned for failed parts

(e) Number and identification of replaced parts

(f) Assembly or subassembly performance level upon receipt at the maintenance activity

(g) Secondary failure identification (if applicable)

(h) Test and check-out performance after repair

(i) Date failed equipment received

(j) Date equipment repair completed

TABLE S-2

INFORMATION CONTENT FOR FAILURE REPORT FORM

1. Reporting Activity	9. Failure-Discovered Code
2. Date of Report Submittal	10. Failure-Verified Code
3. Equipment-Identification Code [EIC] (See Note 1)	11. Disposition-of-Failed Equipment Code
4. How Malfunctioned Code	12. Replacement EIC (See Note 2)
5. Symptom Code	13. Environment Code
6. Effect Code	14. Cause of Malfunction (Code or Narrative)
7. Operating Time at Failure	15. Operating or Performance-Level Code
8. Date and Clock Hour of Malfunction	

MAINTENANCE DATA:

	Start	Stop	Type of Maintenance
17. Tech. Rate	21. Date & Clock Hour	25. Date & Clock Hour	29. Action Code
18. Tech. Rate	22. Date & Clock Hour	26. Date & Clock Hour	30. Action Code
19. Tech. Rate	23. Date & Clock Hour	27. Date & Clock Hour	31. Action Code
20. Tech. Rate	24. Date & Clock Hour	28. Date & Clock Hour	32. Action Code

Note 1: This code starts with the system identification and continues with the identifications for assembly, component, LDA, part, serial number, and reference designator or circuit symbol. Each level of maintenance completes the code as far as its information allows.

Note 2: Serial numbers only unless EIC is changed.

3.2 Recommendations for the Data Feedback System

During the study, it was observed that certain additional functions will be required to properly implement the recommendations made for reporting reliability and maintainability data elements. The following recommendations result from these observations:

(1) Guidance manuals should be developed and training programs conducted in two areas, as follows:

(a) Management use of reliability and maintainability data outputs as decision factors equal in importance to cost, schedule, manpower, and equipment performance

(b) Data collection by technicians and maintenance personnel

The latter training should be conducted either as part of technical rating requirements or in the form of courses for proficiency increases.

(2) The Navy should prepare a guide that standardizes data-element terms and definitions for the MDCS (Ships) and MDCS (Aviation) manuals and clarifies the relationships between the data elements in continuing Navy data systems, expiring Navy data systems, data banks, other military data systems such as AFM-66-1 and TAERS, and manufacturer's data systems. The guide would assist analysts, data processors, and technical personnel in applying all the available data.

(3) Computer programs should be developed to provide summary outputs rather than simple lists of information from failure reports. The programs should be designed to allow inclusion of data collected during each of the equipment's life-cycle phases. They should have the following capabilities:

   (a) To automatically retain equipment-identification (bookkeeping) data such as manufacturer, manufacturer's model number, design-change numbers, dates of incorporation of design changes, contract numbers, etc. Such a memory capability will allow many data-elements to be reported only once.

   (b) To compute MTBF, MTTR, equipment availability, and the associated summary data required for percentage or trend-change analysis

   (c) To extract computed data by - as a minimum - reporting activity, equipment identification, or failed part identification.

(4) Data generated from other Navy sources, such as CASREPS and OPTEVFOR, should be programmed into the MDCS central data-processing system.

CONTENTS

CONTENTS (continued)

1. INTRODUCTION

This report describes the results of a study whose primary objectives were as follows:

(1) To describe the potential use of a comprehensive reliability and maintainability data-feedback system by Navy management personnel

(2) To identify the data-elements that must be supplied by the Fleet, Naval Air Stations, manufacturers, laboratories, and test facilities for use in a comprehensive reliability and maintainability data-feedback system for Naval weapons systems

The data-feedback system was to provide the information required for effective measurement, problem definition, evaluation, prediction, and management of existing or future Naval equipments by generating the following specific items:

(1) Reliability and maintainability indexes in terms of mean time between failure (MTBF), probability of mission success, mean time to repair (MTTR), and system availability

(2) Failure rates of parts and assemblies

(3) Data for use in isolating design, support, and maintenance deficiencies and providing a basis for initiating appropriate corrective actions

(4) Data for use in assessing equipment performance, design-modification needs, and compliance with contractual requirements

(5) Data for conversion to cost information

The following contraints were to be recognized:

(1) The system must provide reliability and maintainability outputs that are useful to military, industrial, and design-engineering users.

(2) The outputs must be in sufficient detail to offer effective guidance in establishing the requirements of current and future equipments and systems.

(3) The system must minimize the possibility of duplicate reporting.

(4) The system must accept data inputs from Fleet, Naval Aviation, manufacturer, laboratory, and test-facility operations.

(5) The system must fulfill the needs of naval support functions, and sea and air operations.

(6) Inputs to the system must be collected from equipment at the assembly, subassembly, component, and part levels.

(7) Inputs to the system must be justified on the basis of need and the methods and techniques to be used in evaluating system effectiveness.

2. MANAGEMENT USE OF RELIABILITY AND MAINTAINABILITY DATA

Adequate system reliability and maintainability characteristics are essential to achieving satisfactory mission effectiveness of Navy weapons systems. These supporting characteristics provide measureable monitoring parameters equal in importance to cost, schedule, and design performance. Therefore, they deserve careful management consideration during decision-making and program-monitoring activities. SECNAV Instruction 3900.36 dated 27 January 1966 delineates policy for the reliability of Naval material and assigns the management responsibilities during the various phases of the material life cycle. Adequate data must be collected and made available to the Navy managers and Fleet Commanders if they are to be able to comply with this instruction.

The effectiveness of a data-feedback system may be gauged by its ability to supply answers to questions such as the following:

(1) Is the malfunction or deficiency the result of inadequacies in maintenance, design, workmanship, material or operating procedures?

(2) Does the failure rate exceed the pre-established control limits?

(3) What is the probability of mission success?

(4) What are the operating hours at the time of failure?

(5) What is the mean time to failure?

(6) What failures are occurring on a specific class of ship or type of aircraft, in a certain geographical environment, at a particular base, etc.?

(7) Can the failure be attributed to environmental conditions?

(8) What is the ground or in-flight abort rate?

(9) Has a given component or system failed excessively in other applications?

(10) Is the system or support equipment being operated within design specification limits?

(11) What system, subsystem, component, or parts are contributing to the highest number of maintenance actions and requiring the highest number of man-hours for repairs?

(12) What is the mean time to repair?

(13) Can the material-control spares support the maintenance effort without delaying men or equipment? Does the failure require tender support, intermediate support, or depot support?

(14) What is the expected downtime or loss of availability for certain failures?

(15) Does maintenance of the system require special skills?

(16) How many technicians and of what classes are needed for efficient maintenance of the system?

(17) In what other functional modes can the system operate under degraded conditions of operation?

(18) What design modifications should be proposed?

(19) Are the maintenance actions on a particular system increasing in frequency?

These questions concern manpower, costs, support equipment, equipment capabilities: the answers, which would directly affect management decisions, are not being provided by the current data-collection systems. For example, outputs from the current MDCS are usually tabulated print-outs of the data submitted on the report forms. This output does not lend itself to management use because of the tedious computations required to obtain suitable information from it. Again, although the existing Navy MDCS does provide for the collection of certain data elements required for reliability and maintainability analyses, it does not collect them in sufficient detail.

The following sections discuss some management tools provided by reliability and maintainability data during the three phases of an equipment's life cycle: the research and development phase, the design and preproduction phase, and the operation phase.

2.1 Use of Data During Research and Development

Some of the more important management applications of reliability and maintainability data during research and development are discussed in the following paragraphs.

2.1.1 Compliance with Requirements

Prediction of the proposed equipment's reliability and maintainability informs management of the design's ability to achieve requirements established in the ADO's, TSOR's and SOR's. Data for these predictions are usually obtained from the following sources:

(1) MIL-HDBK-217A

(2) MIL-STD-756A

(3) FARADA/IDEP

(4) University of Pennsylvania's Monitor Data System

(5) Manufacturers and laboratories

This prediction assumes a "best design" and should be equal to or better than the requirements. Predicted MTBF's below the equipment's requirements warrant immediate management attention and action. Failure to achieve predictions equal to the requirements often results in later penalties in cost, schedule, or effectiveness because the reliability of the end product seldom exceeds the best prediction.

2.1.2 Test Requirements

The reliability prediction for the design selected for development provides technical guidance for planning the reliability testing of the models. The test plan and its subsequent implementation again affect costs and schedules. The results of the actual tests will provide the manager with the first measured assessment of the equipment.

2.1.3 Specification Development

The results of the initial reliability prediction provide valuable inputs to the preparation of the equipment specifications. With such inputs, the specification will accurately describe achievable requirements for the equipment. This in turn results in more satisfactorily negotiated and administered contracts; subsequent trade-offs in performance, reliability, maintainability, costs, schedules, and support requirements can be more equitably evaluated and judged.

2.2 Use of Data During Design and Preproduction

Some management applications of reliability and maintainability data during design and preproduction are discussed in the following paragraphs.

2.2.1 Evaluation of Contract Progress

Manufacturer and test-facility reliability data can supply one of the best progress-evaluation parameters available to Navy managers. Most large manufacturers complying with quality specifications are adept at collecting data. This is particularly true for the test facilities. With little additional effort, valuable reliability data can be obtained, providing the Navy program manager gives careful thought to specifying the data required. For example, the results of monitoring the time schedule for completing engineering-design testing of breadboard equipment are often as valuable as are the test data themselves. Predictions of the equipment reliability, based on the failure rates of the parts selected for the production equipment, are as important as the initial reliability prediction; reliability data obtained from bench and environmental tests on the parts in their assembled configuration generate the most important information for contract progress evaluation. Failures, operating time at failure, total accumulated time, number of parts replaced or repaired, maintenance man-hours, cause of failure, accurate identification of the equipment, and the environment associated with the test can all be used to monitor the equipment's progress and to ensure that problems are properly corrected.

Computerized calculations of the reliability and maintainability data, correlated with equipment identification and design changes and compared to program schedules and costs, will provide the necessary information for progress evaluation of the contractual commitments. This data will also assist the Navy manager in identifying uncorrected failures and aid in establishing adequate spare-part provisioning.

2.2.2 Other Uses

Reliability and maintainability data can be applied by the Navy manager in performing the following tasks:

(1) Evaluation of Test Results

(2) Determining Acceptance Criteria

(3) Establishing Training Requirements

(4) Developing Maintenance Policies

(5) Predicting Operational-Use Costs

(6) Product Improvement Planning

(7) Manufacturer Evaluation

2.3 Use of Data During Operation

In the final analysis, the true evaluation of an equipment's effectiveness is in the operational enviroment. In addition, the data produced during Naval operations can be used to evaluate the reliability and maintainability predictions, analyses, and test measurements obtained during the previous phases. This completed cycle accrues to the benefit of the next system acquired. Some specific uses of the data for future system acquisition are as follows:

(1) Development of realistic equipment specifications and requirements

(2) Improvement of logistic planning and provisioning

(3) Improvement of shipboard and Naval Air Station repair parts allocations

(4) Reduction of operating costs

(5) Reduction of periods of reporting on operational equipments

The collected data can be used by management for more immediate results in the same manner as the data obtained during the design and preproduction phase.* A data-feedback system at the operations level must necessarily limit its objective to general problem identification and cannot replace the requirement for special reporting to identify and correct specific problems. However, general problem identification significantly reduces the time period required to isolate specific

*Case studies are presented in Appendix A to illustrate the need for and use of operations data in decision making and problem resolution.

problems and would provide a forewarning of an increase in occurrences of CASREPS. Such advanced notice would allow the technical systems managers to speed corrective action and possibly correct the problem before it becomes critical. The current reporting system does not permit this.

Finally, the Fleet reliability and maintainability data would provide strategic and tactical management personnel with a more accurate evaluation of total Fleet readiness, capability, and probability of success.

2.4 Application of Statistical Computations

Many of the outputs from a data-feedback system must be converted to a useful form by statistical computations before being distributed to management personnel. Some aspects of these computations are presented in Appendix B. Much of this work can be performed by electronic-data-processing equipment.

3. REQUIREMENTS OF THE DATA-FEEDBACK SYSTEM

Requirements for reliability and maintainability data reporting by the Fleet, Naval Air Stations, manufacturers, laboratories, and test facilities were established during the study in reference to the three phases in an equipment's life cycle. Manufacturers and laboratories were considered to be the major contributors of data during Phase 1 (research and development); test facilities and manufacturers during Phase 2 (design and preproduction); and the Fleet, Naval Air Station, shipyards, and depots, supported by some manufacturer reporting, during Phase 3 (operation).

Determination of the data elements required to fulfill management's needs was based on information obtained as follows:

(1) Extraction of appropriate information from publications of private reliability-research organizations

(2) Reference to applicable military, manufacturer, and other documentation

(3) Discussions with representatives of various Navy agencies concerned with the use, collection, and processing of reliability and maintainability data.

This review and survey work, discussed in more detail in Section 4, resulted in the compilation of a comprehensive tabulation of reliability and maintainability data elements being collected by military and civilian activities. This tabulation was used as a basic information source during the couse of the study and is presented as such in Appendix C. It was observed that many of the data-elements required for effective reliability and maintainability analysis are being collected somewhere, but that no single system collects them all. Confusion is added by the inconsistencies that abound in data-element names and definitions.

3.1 Data-Element Collection Requirements

Table 1 lists the data elements that the sub-working group recommends should be collected during the life cycle of an equipment. Identification of the phase during which each element should be collected, a definition of each data element, and the major justification for collecting each data element are included. The table is arranged in three classifications as follows:

(1) Bookkeeping Elements - These identify equipments and sources of data, and provide other information necessary for accurate retrieval and correlation.

(2) Time, Cycle, and Date Elements - All time-related data elements are included in this classification regardless of their eventual application.

TABLE 1

RECOMMENDED DATA-ELEMENT REQUIREMENTS
FOR RELIABILITY AND MAINTAINABILITY DATA-FEEDBACK SYSTEM

Data Element	Life-Cycle Phase* 1	2	3	Definition	Major Justification
Bookkeeping					
Reporting Activity				Identification of the data source	To identify the location of the equipment when the event occurred.
Equipment Identification Code Number (EIC), or Federal Stock Number (FSN) or Work Unit Code (WUC)				The equipment identification code number from catalog	To provide equipment or part identification
Name of Equipment				Identification of the equipment at the highest assembly level	To maintain record of malfunctions by equipment identification
Manufacturer's Model Number for the Equipment				Manufacturer's model number for the equipment	To identify equipment or system by model number
Serial Number of Equipment				Manufacturer's serial number assigned to the equipment	To maintain record of malfunctions by equipment serial number
Equipment Manufacturer's Name or Code				Identification of manufacturer of equipment	To monitor manufacturer's performance
Contract Number				Identification of contract under which the equipment was produced	To assist in monitoring contractor compliance with equipment specifications and warranties
Name of Failed Assembly				Identification of the assembly in which the malfunction occurred	To maintain record of malfunctions by assembly designation
Manufacturer of Failed Assembly				Identification of manufacturer of assembly in which failure occurred	To monitor manufacturer's performance and identify problems
Drawing Number or Federal Stock Number of Failed Assembly				Manufacturer's drawing number or FSN of assembly in which failure occurred	To identify the particular assembly design
Name of Failed Part				Identification of the failed part	To maintain a record of malfunctions by part identification
Manufacturer's Part Number or Federal Stock Number for Failed Part				Manufacturer's Part number or failed stock number for the failed part	To identify the failure by part number
Serial Number of Failed Part (if applicable)				Manufacturer's serial number of the failed part	To maintain record of malfunctions by part serial number
Manufacturer of Failed Part				Identification of manufacturer of failed part	To monitor manufacturer's performance and identify problems
Drawing Reference Designator or Circuit Symbol of Failed Part				Manufacturer's drawing reference, circuit symbol, or other identification of the application of the failed part	To analyze application stresses
Manufacturer of Replacement Part				Identification of manufacturer of replacement part	To maintain configuration control

* Phase 1 - Research and Development Phase
Phase 2 - Design and Preproduction Phase
Phase 3 - Operation Phase

(continued)

TABLE 1 (continued)

Data Element	Life-Cycle Phase 1	2	3	Definition	Major Justification
Serial Number (where applicable) of Replacement Part	▨	▨	▨	Serial number of replacement part	To maintain configuration control
Technical Rating of Maintenance Personnel			▨	Navy technical rating of personnel who performed the maintenance	To monitor the adequacy of technical-personnel assignments
Applicable Technical Manuals			▨	Identification (including revision number) of manuals, drawings, instructions, etc. used by maintenance personnel	To monitor adequacy and availability of technical support documents
Name of Test Facility	▨	▨		Identification of the facility conducting the test if this is different from the reporting activity	To identify location of equipment when failure occurred
Time, Cycle, and Date					
Date of Report	▨	▨	▨	Calendar date of report	To monitor efficiency of failure-reporting system
Date of Malfunction		▨	▨	Calendar date malfunctioned was observed	To monitor sequence of failure and to trace environmental conditions
Operating Time on the Specific Equipment when Malfunction Occurred	▨	▨	▨	Operating Time on the Specific Equipment when Malfunction Occurred	To compute equipment failure distributions with time
Number of cycles, starts, landings etc. on the malfunctioning equipment when the malfunction occurred (if applicable)	▨	▨	▨	Number of cycles, starts, landings etc. on the malfunctioning equipment when the malfunction occurred	To compute equipment failure distributions with cycles
Accumulated Operating Time on all equipments (Periodic Reporting)	▨	▨	▨	Accumulated Operating time on all equipments	To compute failure rates
Accumulated cycles, starts landings etc. on all equipments. (Periodic Reporting)	▨	▨	▨	Accumulated cycles, starts landings etc, on all equipments	To compute failure rates
Date Maintenance Started		▨	▨	Calendar date maintenance started	To compute equipment MTTR and availability
Date Maintenance Ended		▨	▨	Calendar date maintenance ended	To compute equipment MTTR and availability
Clock Time Maintenance Started		▨	▨	Time maintenance started	To compute equipment MTTR and availability
Clock Time Maintenance Ended		▨	▨	Time maintenance ended	To compute equipment MTTR and availability
Active Maintenance Man-Hours		▨	▨	Active repair time for preventive and corrective maintenance actions	To compute Maintenance Support Index of the equipment and cost of repair
Man-Hours to Diagnose Malfunction		▨	▨ †	Total number of man-hours required to identify the functional problem area	To assess ease of problem identification
Man-Hours to Gain Access to Malfunctioned Part		▨	▨ †	Total number of man-hours required to gain access to malfunctional part	To assess ease of physical access to the problem area
Man-Hours to Repair, Replace, or Adjust malfunctioned Part		▨	† ▨	Total number of man-hours required to repair, replace, or adjust the malfunctioned part	To assess ease of repair

† Collected during initial period of operation (length of period depends on equipment classification).

(continued)

TABLE 1 (continued)

Data Element	Life-Cycle Phase 1	2	3	Definition	Major Justification
Technical Support					
Environment when Malfunction Occurred				Identification of natural and functional environment when equipment failed	To analyze the effect of environment on reliability
Equipment Operation at Time of Malfunction				Equipment operation when failure occurred. (Full load, flank speed, cruise, idle, static, energized, radiating, off, etc.	To analyze stresses present when failure occurred
Effect of Malfunction on Equipment Operation				Description of equipment performance after failure occurred	To assess equipment capability in a degraded mode
Symptoms of Malfunction				Description of abnormal manifestations at time of malfunction	To assist in problem identification and verification
Malfunction Verified				Verification that the part failed	To ensure accuracy in reliability computations
Cause of Malfunction				Comments or suggestions from the responsible technician	To assist in problem identification
Condition of Failed Part (How Malfunctioned)				Description of failed part such as broken, bent, burned, etc.	To assist in problem identification
Primary or Secondary Failure				Information on whether this was a primary failure or one caused by failure of another part	Required to evaluate failure cause, mode, to censor failures, and to assess failure effect
Disposition of Replaced Part				Description of what was done with the failed part after removal, such as repaired, returned to contractor, scrapped	To provide a record of final disposition for cost and failure analysis
Is a Follow-Up Report Required?				No, if repair has been completed; Yes, if repair has not been completed or if analysis of failed parts is to be performed	To alert analyst if additional maintenance or data is involved
Type of Test Being Conducted				Name of test, with description and purpose	To identify the controlled operating conditions
Number of Equipments Under Test				Total number of equipments of the same type under the same test	To compute probability of success (total population required)

(3) Technical Support Elements - These provide the technical information required for analysis and problem identification.

The requirements for reporting from shipyards are based on a study performed by Code 1820, Philadelphia Naval Shipyard. Documentation on the results of this study is presented, as received from Code 1820, in Appendix D; a listing of the proposed data-element requirements from shipyards is included. Differences between these recommendations and those detailed in this report are associated with accounting and administration only.

3.2 Data-Element Collection Status

Findings and conclusions resulting from comparison of the data elements recommended for collection with the data elements currently being collected through Navy data systems, other military data systems, and manufacturer reporting systems will be discussed for the three life-cycle phases in turn.

3.2.1 Research and Development Phase

3.2.1.1 Status

Table 2 presents a summary of the current availability and collection status of data elements that should be acquired during the equipment's research and development phase. The following notes amplify the information contained in the table:

(1) FARADA and the University of Pennsylvania's Monitor Data System receive reliability inputs in summary form rather then as data elements. However, the content of the data does not permit the computation of failure distributions.

(2) There are no provisions under FARADA for collecting maintenance data.

(3) Collection of reliability and maintainability data has been a secondary objective of the University of Pennsylvania's Monitor Data System. This situation is expected to be changed but it is not known when.

(4) Computed values of MTBF and MTTR are submitted to the University of Pennsylvania's Monitor Data System, but the submitting activity itself must perform the computation.

(5) The MEARS System (WR-30) is primarily a program-management and administrative-control system for monitoring compliance with maintainability and reliability contractual requirements. Emphasis is placed on maintainability data.

(6) Contractors normally collect the data elements that are necessary for reliability and maintainability analyses, but they are not always required to report the results.

TABLE 2

STATUS OF DATA-ELEMENT FEEDBACK
- RESEARCH AND DEVELOPMENT PHASE -

Data Element	Collection Status*			
	FARADA	University of Pennsylvania	MEARS	Manufacturers
Bookkeeping				
Reporting Activity	X	X	X	X
Name of Equipment	X	X	X	X
Manufacturer's Model Number for the Equipment	O	O	X	X
Serial Number of Equipment	N	N	O	X
Equipment Manufacturer's Name or Code	O	O	X	O
Contract Number	O	X	X	X
Name of Failed Part	X	X	O	X
Manufacturer's Part Number or Federal Stock Number for Failed Part	O	O	X	X
Serial Number of Failed Part (if applicable)	O	O	O	X
Manufacturer of Failed Part	O	X	O	X
Drawing Reference Designator or Circuit Symbol of Failed Part	O	X	X	O
Manufacturer of Replacement Part	N	N	X	X
Serial Number (where applicable) of Replacement Part	N	N	O	X
Name of Test Facility	N	N	O	X
Time, Cycle, and Date				
Date of Report	X	X	O	X
Operating Time on the Specific Equipment when Malfunction Occurred	O	O	X	X
Number of Cycles, Starts, Landings etc. on the malfunctioning equipment when the malfunction occurred (if applicable)	O	O	X	X
Accumulated Operating Time on all Equipments (Periodic Reporting)	X	O	X	X
Accumulated Cycles, Starts, Landings etc. on all Equipments. (Periodic Reporting)	N	N	N	O

X - Currently being collected

O - Available but not being collected

N - Not available or not applicable

*See Appendix E for reference sources

(Continued)

TABLE 2 (continued)

Data Element	Collection Status*			
	FARADA	University of Pennsylvania	MEARS	Manufacturers
Technical Support				
Environment when Malfunction Occurred	N	N	O	O
Equipment Operation at Time of Malfunction	X	O	X	O
Effect of Malfunction on Equipment Operation	N	O	X	O
Symptoms of Malfunction	O	O	O	X
Malfunction Verified	X	N	O	X
Cause of Malfunction	O	O	X	X
Condition of Failed Part (How Malfunctioned)	X	N	O	X
Primary or Secondary Failure	N	N	O	X
Type of Test Being Conducted	X	O	O	O

X - Currently being collected

O - Available but not being collected

N - Not available or not applicable

* See Appendix E for reference sources.

3.2.1.2 Conclusions

Conclusions that are applicable to data-element collection in the research and development phase of an equipment's life cycle are as follows:

(1) In general, more data elements are collected by manufacturers that can be assimilated by the three data systems currently in use by the Navy. The Navy has no consistent approach to data-element collection during the research and development phase. Policy in this matter is largely controlled by the cognizant Navy project manager and, to some extent, by the manufacturer. As a result, there is a wide variation in the quality and quantity of data elements collected and reported by the various research and development programs.

(2) A reliability program conducted in compliance with MIL-STD-785 and SECNAVINST 3900.36 will supply information that is adequate for Navy management use in a particular project. However, these documents do not require that the information be passed on to external activities, such as Navy central data banks. Instructions for maintainability programs are even less comprehensive.

(3) Neither FARADA nor the University of Pennsylvania's Monitor Data System specifies a computational procedure to be used when data are submitted in summary form, i.e., as MTBF or MTTR values.

3.2.2 Design and Preproduction Phase

3.2.2.1 Status

Table 3 presents a summary of the current availability and collection status of data-elements that should be acquired during an equipment's design and preproduction phase. The following notes amplify the information contained in the table:

(1) The comments in Section 3.2.1.1 concerning the data-collection status in the research and development phase are also applicable to the design and preproduction phase.

(2) It is apparent that better reliability and maintainability data are available during design and preproduction than are previously available.

(3) OPTEVFOR has a comprehensive reliability and maintainability program for the assessment of preproduction equipments prior to approval for Navy operational use. However, there is no requirement for submittal of this data to Navy data banks.

3.2.2.2 Conclusions

Conclusions that are applicable to data-element collection in the design and preproduction phase of an equipment's life cycle are as follows:

TABLE 3

STATUS OF DATA-ELEMENT FEEDBACK
- DESIGN AND PREPRODUCTION PHASE -

Data Element	Collection Status*				
	OPTEV-FOR	FARADA	University of Pennsylvania	MEARS	Manufacturers
Bookkeeping					
Reporting Activity	X	X	X	X	X
Equipment Identification Code Number (EIC), or Federal Stock Number (FSN), or Work Unit Code (WUC)	X	X	X	X	X
Name of Equipment	X	X	X	X	X
Manufacturer's Model Number for the Equipment	X	O	O	X	X
Serial Number of Equipment	X	N	N	O	X
Equipment Manufacturer's Name or Code	O	O	O	X	O
Contract Number	X	O	X	X	X
Name of Failed Assembly	O	N	X	X	X
Manufacturer of Failed Assembly	O	O	O	O	X
Drawing Number or Federal Stock Number of Failed Assembly	O	O	X	X	X
Name of Failed Part	X	X	X	O	X
Manufacturer's Part Number or Federal Stock Number for Failed Part	O	O	O	X	X
Serial Number of Failed Part (if applicable)	X	O	O	O	X
Manufacturer of Failed Part	O	O	X	O	X
Drawing Reference Designator or Circuit Symbol of Failed Part	X	O	X	X	O
Manufacturer of Replacement Part	O	N	N	X	X
Serial Number (where applicable) of Replacement Part	O	N	N	O	X
Name of Test Facility	O	N	N	O	X
Time, Cycle, and Date					
Date of Report	X	X	X	O	X
Date of Malfunction	X	O	O	O	X
Operating Time on the Specific Equipment when Malfunction Occurred	X	O	O	X	X

X - Currently being collected

O - Available but not being collected

N - Not available or not applicable

*See Appendix E for reference sources

(Continued)

TABLE 3 (continued)

Data Element	Collection Status*				
	OPTEV-FOR	FARADA	University of Pennsylvania	MEARS	Manufacturers
Number of Cycles, Starts, Landings, etc. on the Malfunctioning Equipment when the Malfunction occurred (if applicable)	O	O	O	X	X
Accumulated Operating Time on all Equipments (Periodic Reporting)	X	X	O	X	X
Accumulated Cycles, Starts, Landings, etc. on all Equipments. (Periodic Reporting)	O	N	N	N	O
Date Maintenance Started	X	O	X	O	O
Date Maintenance Ended	X	O	O	O	O
Clock Time Maintenance Started	X	O	O	O	O
Clock Time Maintenance Ended	X	O	O	O	O
Active Maintenance Man-Hours	X	O	O	X	O
Man-Hours to Diagnose Malfunction	O	N	N	O	X
Man-Hours to Gain Access to Malfunctioned Part	X	O	O	O	O
Man-Hours to Repair, Replace, or Adjust Malfunctioned Part	X	N	N	X	O
Technical Support					
Environment when Malfunction Occurred	X	N	N	O	O
Equipment Operation at Time of Malfunction	X	X	O	X	O
Effect of Malfunction on Equipment Operation	X	N	O	X	O
Symptoms of Malfunction	O	O	O	O	X
Malfunction Verified	O	X	N	O	X
Cause of Malfunction	X	O	O	X	X
Condition of Failed Part (How Malfunctioned)	X	X	N	O	X
Primary or Secondary Failure	X	N	N	O	X
Disposition of Replaced Part	O	N	N	O	X
Is a Follow-up Report Required?	O	O	O	O	O
Type of Test Being Conducted	X	X	O	O	O
Number of Equipment Under Test	O	X	O	O	X

X - Currently being collected

O - Available but not being collected

N - Not available or not applicable

*See Appendix E for reference sources

(1) The conclusions concerning data-element collection in the research and development phase (see Section 3.2.1.2) are also applicable to the design and preproduction phase.

(2) Although the design and preproduction phase of an equipment's life cycle is capable of generating the most accurately monitored and detailed data, the current procedure for collecting these data is inadequate. Manufacturers, laboratories, and test facilities have no consistent instruction for submitting their test data to Navy data banks.

(3) The following data elements are currently requested by certain Navy data banks (identified in parentheses) but are not included on the contractors' report forms reviewed during this task:

(a) Drawing reference designation or circuit symbol (MEARS)

(b) Type of test being conducted (FARADA)

(c) Number of equipments under test (FARADA)

(d) Environment when malfunction occurred (FARADA)

(e) Equipment operation at time of malfunction (FARADA)

3.2.3 Operation Phase

3.2.3.1 Status

Table 4 presents a summary of the current availability and collection status of data elements that should be acquired during the equipment's operation phase. The table indicates that a large amount of data is being collected, but that many of the most useful data are omitted; for example, the following critical items of information are not always collected:

(1) Identification at the part level of the equipment on which maintenance is performed*

(2) Periodic reports of system operating times*

(3) Date of malfunction occurrence

(4) Operating characteristics*

(5) Type of operation when failure occurred*

(6) Identification of manufacturer*

(7) Maintenance man-hours spent in active repair*

(8) Breakdown of repair-activity man-hours

(9) Date maintenance completed*

(10) System downtime in calendar hours

(11) System operating time at malfunction*

(12) Technician's rate and specialty

*Collected for MDCS (Aviation), not collected for MDCS (Ships).

TABLE 4

STATUS OF DATA-ELEMENT FEEDBACK
- OPERATION PHASE -

Data Element	Collection Status*					
	MDCS (3M)		CasReps	Manufacturers	Air Force AFM-66-1	Army TAERS
	Ships	Aviation				
Bookkeeping						
Reporting Activity	X	X	X	X	X	X
Equipment Identification Code Number (EIC), or Federal Stock Number (FSN) or Work Unit Code (WUC)	X	X	X	N	X	X
Name of Equipment	X	X	X	X	X	X
Manufacturer's Model Number for the Equipment	O	X	N	X	O	X
Serial Number of Equipment	X	X	N	X	X	X
Equipment Manufacturer's Name or Code	O	X	N	O	O	O
Name of Failed Assembly	X	X	O	X	O	O
Manufacturer of Failed Assembly	O	O	N	X	O	O
Drawing Number or Federal Stock Number of Failed Assembly	O	X	X	X	O	X
Name of Failed Part	X	O	X	X	O	X
Manufacturer's Part Number or Federal Stock Number for Failed Part	O	X	O	X	O	O
Serial Number of Failed Part (if applicable)	O	X	N	O	O	O
Manufacturer of Failed Part	O	X	N	X	O	X
Drawing Reference Designator or Circuit Symbol of Failed Part	O	O	N	O	O	X
Manufacturer of Replacement Part	O	X	N	X	O	O
Serial Number (where applicable) of Replacement Part	O	X	N	X	X	O
Technicians Rating of Maintenance Personnel	O	O	N	N	O	X
Applicable Technical Manuals	O	O	N	N	O	O
Time, Cycle, and Date						
Date of Report	X	X	X	X	X	X
Date of Malfunction	O	O	X	X	O	O
Operating Time on the Specific Equipment when Malfunction Occurred	O	X	O	X	X	O
Number of Cycles, Starts, Landings etc. on the Malfunctioning Equipment when the Malfunction Occurred (if applicable)	O	X	O	X	X	O
Accumulated Operating Time on all Equipments (Periodic Reporting)	O	O	N	X	X	O
Accumulated Cycles, Starts, Landings, etc. on all Equipments. (Periodic Reporting)	O	O	N	O	O	O

X - Currently being collected

O - Available but not being collected

N - Not available or not applicable

*See Appendix E for reference sources

(Continued)

TABLE 4 (continued)

Data Element	Collection Status*					
	MDCS (3M)		CasReps	Manufacturers	Air Force AFM-66-1	Army TAERS
	Ships	Aviation				
Date Maintenance Started	O	X	N	O	X	X
Date Maintenance Ended	X	X	N	O	O	O
Clock Time Maintenance Started	O	X	N	O	X	X
Clock Time Maintenance Ended	O	X	N	O	O	O
Active Maintenance Man-Hours	O	X	N	O	X	O
Man-Hours to Diagnose Malfunction	O	O	N	O	O	O
Man-Hours to Gain Access to Malfunctioned Part	O	O	N	O	O	O
Man-Hours to Repair, Replace, or Adjust Malfunctioned Part	O	O	N	O	O	X
Technical Support						
Environment when Malfunction Occurred	O	O	O	O	O	X
Equipment Operation at Time of Malfunction	O	O	O	O	O	O
Effect of Malfunction on Equipment Operation	X	X	X	O	O	X
Symptoms of Malfunction	O	X	N	X	O	O
Malfunction Verified	O	O	X	X	O	O
Condition of Failed Part (How Malfunctioned)	X	X	O	X	X	X
Dispostion of Replaced Part	O	X	N	X	O	X
Is a Follow-Report Required?	O	O	N	O	O	O

X - Currently being collected
O - Available but not being collected
N - Not available or not applicable

*See Appendix E for reference sources

To obtain a measure of the ability of the MDCS to collect more comprehensive data, the reporting of nine additional data elements was recently required on a trial basis. All the additional elements can be collected during the standard active-maintenance cycle, as can all the operation-phase elements recommended in Table 1. The nine additional data-elements are identified as follows:

(1) Equipment operating time

(2) Part failure modes

(3) Part failure cause

(4) Effect of failure on operational status

(5) Equipment downtime

(6) Failed part source (manufacturer)

(7) Serial number of failed assembly, modules, and LDA

(8) Active repair time, including calendar time and man-hours

(9) Rates and specialties of maintenance technicians

The comprehensive tabulation of data elements currently being collected (Appendix C) provides a source for comparison of the various military data systems in use at the operations level. For example, the bookkeeping data-element requirements of the MDCS (Ships) (including the nine trial data elements and the expiring BuWeps Form 13070/3) appear to be comparable to the requirments of Air Force AFM-66-1. In the Time, Cycle, and Date category, the ARMMS and MEARS reporting supplies many of the inputs for reliability and maintainability analysis, but these systems do not provide Time, Cycle and Date information to the extent collected by the AFTO 210, 211, and 212 forms of AFM-66-1. The various military systems appear to be collecting operational technical support data at an approximately equal level of quality and quantity. However, all the systems fail to collect environmental data for the time of equipment malfunction. This is a serious deficiency, since such information is important in problem identification and in the assessment of equipment effectiveness.

3.2.3.2 Conclusions

(1) The current MDCS (Ships and Aviation), emphasizes the collection of accounting, manpower, and equipment-support data, which do not fulfill the needs of Navy Fleet, Aviation, or project-office management.

(2) Data-element reporting in compliance with the intent of SECNAV Instruction 3900.36 has not been implemented and consequently technical offices under the Ships Systems Commands cannot comply with their assigned responsibilities.

(3) Electronic computer programs capable of producing calculated reliability, maintainability, and availability measures of operational equipments are not being effectively used with the existing MDCS (Ships) input data.

(4) A general incompatibility of nomenclatures and definitions for data elements exists between MDCS (Ships), MDCS (Aviation), and other Navy operational data-reporting systems, making correlation of data on similar equipments very difficult and time consuming.

(5) Reliability and maintainability data reporting is minimal at the tender and intermediate maintenance levels and nonexistent at the depot and shipyard maintenance levels.

(6) There are no centralized provisions for correlating MDCS data with data obtained during previous equipment life-cycle phases.

4. DOCUMENTATION

4.1 General

Most of the documentation on this investigation consists of trip reports and reports of informal discussions. These are summarized below. Some eighty documents that were received in the course of the study are listed in Appendix E; descriptions of some of the important documents are included.

4.2 Visits and Interviews

This phase of the study was concerned with the collection of procedures and sample forms, and review of the numerous data-documentation systems currently being used by Naval activities. Visits to selected agencies that are using or processing maintenance data and interviews with cognizant personnel were arranged. A brief account of the information obtained at each of the agencies visited follows; examples or facsimilies of the data forms collected are assembled in Appendix F.

4.2.1 Assurance Engineering Field Facility, Philadelphia, Pennsylvania

This activity neither receives data nor generates data summaries. However, it has been assigned the tasks of establishing data-element and documentation requirements for depot-level maintenance reporting for shipyards and test laboratories under the MDCS system. Sample copies of the data reporting forms recommended for use under this program were obtained.

4.2.2 Maintenance Support Office, Mechanicsburg, Pennsylvania

This activity supplies data accumulation, processing, and analysis services to operational and technical Naval commands. The input data elements are derived from the MDCS system covering both surface and aviation activities.

MSO is in the formative stage and much of the work is being performed by other military and contractor activities. Data-product summaries in standard format are presently being developed and produced as requested by Fleet and technical-design activities.

It is anticipated that all Naval maintenance-data collection and analysis will eventually be processed through this activity as the central maintenance-data processing activity for the U. S. Navy.

4.2.3 David Taylor Model Basin, Washington, D. C.

This activity indicated that it acts only as a data storage bank and retrieval facility, preparing data product summaries from the BuShips 10550-1 and 10550-14 data bank as requested by BuShips and Electronics Maintenance Engineering Center, Norfolk, Virginia (ECMR). Key punched cards are received from EMEC NorVA and the data are placed in the data bank. These data are punched by EMEC from NAVShips 10550-1 and 10550-14 data. Currently DTMB can provide a total of 15 separate data-product summaries from BuShips 10550 data.

4.2.4 Electronic Maintenance Engineering Center, Norfolk, Virginia

The data acquisition and analysis group at this activity receives data-element inputs from Naval activities that have not been included in the MDCS system. This data is punched on IBM cards which are forwarded to DTMB for processing and storage in the data bank. Data product summaries processed by DTMB are then analyzed by EMEC personnel in the course of reliability, and maintainability-improvement programs for equipments for which they are assigned responsibility.

At the time of this study, EMEC was attempting to use MDCS data for the first time in recent months; the first group of data was received from ComCruDesLant, Newport, R. I. on 29 March 1966. As the remaining Naval activities are included in the MDCS program, it is expected that EMEC NorVa will begin to use the data-product summaries from MSO Mechanicsburg, Pa. as well as those from ComCruDesLant.

4.2.5 Fleet Work Study Group (FWSG), Norfolk, Virginia

FWGS does not collect or process data. Its function in the MDCS system is to develop and design methods and procedures for obtaining required maintenance data with minimum interference to other duties of Fleet personnel.

FWSG is in the process of establishing procedures and techniques for collecting nine new data elements resulting from conferences at CNM during March 1966. These data elements are required for improved reliability and maintainability determinations.

4.2.6 U. S. Naval Boiler and Turbine Laboratory, Philadelphia, Pennsylvania

The Performance Analysis Branch of this activity is primarily involved with machinery and electrical equipment. They have no formalized data-element inputs and produce no product summaries. Its data are obtained from analysis of NavShips 3621 reporting forms. In addition MDCS data products and Casualty Reports (CASREPS) data are used to determine the causes of problem areas. In addition, special interview-documentation forms are sometimes used to make ship surveys of problem areas.

The Performance Analysis branch provides guidance to other sections of B & TL in the areas of reliability and maintainability.

4.2.7 Naval Applied Science Laboratory, Brooklyn, New York

Several visits were made to this activity to coordinate and obtain documentation for use under this contract. It does not collect any data or provide outputs.

4.2.8 BuWeps Fleet Readiness Representative Atlantic (BWFRRLANT), Norfolk, Virginia

Code 2520, BWFRRLANT has been assigned the task of integrating conventional ordnance equipment into the surface MDCS System. This task has just been started and progress to the date of the visit consisted of the establishment of a local guidance group and the transmittal of a message request to NWS Concord, California requesting delineation of the required data elements.

4.2.9 Patuxent Naval Air Station, Patuxent River, Maryland

The group developing the Automatic Reliability and Maintainability Measuring System (ARMMS) was visited to discuss the system and to determine the type of data elements under study.

The system has not yet been implemented, but will eventually augment the MDCS (Aviation) reporting system during the Bureau of Inspection and Surveys (BIS) trials. ARMMS may be used to verify contractor requirements on military equipments. The system will be maintenance-oriented, requiring reporting of all maintenance-action times from maintenance set-up through the end of the maintenance action. ARMMS is presently being modified and will be field tested on the CH-53 helicopter and A7A aircraft programs by the end of 1966.

5. RECOMMENDATIONS

The following recommendations cover requirements for achieving an integrated Navy data-feedback system that will provide Naval management personnel with adequate information in the areas of equipment reliability, maintainability, and availability. The recommendations are based on conclusions made by NAVLOGSIPS SWG 14.3 during its investigation of military and manufacturer data-collection systems.

5.1 Recommendations for Data-Element Reporting

The reliability and maintainability data-elements specified in Table 1 are the minimum required by Navy management personnel to perform their functional assignments. It is recommended that these reporting requirements be implemented as follows:

(1) Navy Project Offices that have responsibility for prototype-equipment development should be instructed to collect from manufacturers, laboratories, and test facilities the data elements specified for collection during the research and development phase. These data should be transmitted to FARADA and the University of Pennsylvania's Monitor Data System.

(2) COMOPTEVFOR and Navy Project Offices that have responsibility for evaluating preproduction equipments (including modifications to operational equipments) should be instructed to collect the data specified for collection during the design and preproduction phase. The data should be transmitted to the data banks.

(3) A program plan that will result in a cost-effective data-feedback system for the operation phase should be developed and implemented. (The plan should incorporate the recommendations given later in this section.) In the interim, data collection in the operation phase should continue with the following trial elements that have been added to the MDCS (Ships).

- Equipment operating time
- Part failure modes
- Part failure cause
- Effect of failure on operational status
- Equipment downtime
- Failed part source (manufacturer)

- Serial number of failed assembly, modules, and LDA
- Active repair time, including calendar time and man-hours
- Rates and specialties of maintenance technicians

(4) A military standard which classifies equipments by complexity, sensitivity (to handling, maintenance, or operation), technical sophistication, and life expectancy should be developed as a basis for establishing the periods of time after which general reporting may be substituted for detailed reporting. Detailed reporting is defined as the collection and transmittal of all the data elements specified. General reporting is defined as the collection and transmittal of only a selected group of the specified data elements; basic failure reports, periodic operating-time, and other data necessary to compute equipment reliability and availability would be submitted, while elements concerned with environment, symptoms, effect on equipment, detailed maintenance times, and others would not be collected.

The standard should include a collection procedure, based on equipment classification, similar to the following:

(a) During the research and development phase and the design and preproduction phase, detailed data reporting will be required on a continuing basis.

(b) Detailed reporting for a new or a newly modified operational equipment will be conducted for a period based on the equipment's classification or until the equipment stabilizes. General reporting requirements will then continue for a period of six to twelve months, depending on the equipment's classification.

(c) On a yearly or bi-yearly cycle, depending on the equipment's classification, detailed reporting will be resumed for a short period.

This selective reporting procedure would provide sufficient information to monitor equipment effectiveness and wear-out trends, reduce the cost of operating the data-feedback system, and reduce the reporting burden on operations personnel.

(5) The collection procedure included in recommendation 4 might be modified (with some risk to accurate decision making) by requiring that the periodic shift to detailed reporting (item C in the procedure) be made on only a selected sample of equipments; sampling would be based on the equipment classifications.

(6) A tabulated form for data reporting should be developed for use in the operation phase. The form's design should be based on the effective use of electronic data-processing machines and computers so as to relieve Fleet and aviation personnel of the task of performing computations. Additionally, the form should provide for reporting of equipment operating time on a monthly basis.

Table 5 shows the items that should be requested on the form. Each item's general location on the form is shown, but no attempt has been made to establish an effective layout or design.

TABLE 5

INFORMATION CONTENT FOR FAILURE REPORT FORM

1. Reporting Activity	9. Failure-Discovered Code
2. Date of Report Submittal	10. Failure-Verified Code
3. Equipment-Identification Code (See Note 1)	11. Disposition-of-Failed-Equipment Code
4. How-Malfunctioned Code	12. Replacement EIC (See Note 2)
5. Symptom Code	13. Environment Code
6. Effect Code	14. Cause of Malfunction (Code or Narrative)
7. Operating Time at Failure	15. Operating or Performance-Level Code
8. Date and Clock Hour of Malfunction	

MAINTENANCE DATA:

	Start	Stop	Type of Maintenance
17. Tech. Rate	21. Date & Clock Hour	25. Date & Clock Hour	29. Action Code
18. Tech. Rate	22. Date & Clock Hour	26. Date & Clock Hour	30. Action Code
19. Tech. Rate	23. Date & Clock Hour	27. Date & Clock Hour	31. Action Code
20. Tech. Rate	24. Date & Clock Hour	28. Date & Clock Hour	32. Action Code

Note 1: This code starts with the system identification and continues with the identifications for assembly, component, LDA, part, serial number, and reference designator or circuit symbol. Each level of maintenance completes the code as far as its information allows.

Note 2: Serial numbers only unless EIC is changed.

(7) Part-replacement data should be reported at the intermediate, tender, shop, and depot maintenance levels. To support Navy cost-effectiveness evaluations, the following minimum information is required:

(a) Maintenance man-hours at the assembly or subassembly level

(b) EIC and serial number

(c) Part replacement identification, including LDA, part number, and reference designation or circuit symbol identification

(d) How malfunctioned for failed parts

(e) Number and identification of replaced parts

(f) Assembly or subassembly performance level upon receipt at the maintenance activity

(g) Secondary failure identification (if applicable)

(h) Test and check-out performance after repair

(i) Date failed equipment received

(j) Date equipment repair completed

5.2 Recommendations for the Data-Feedback System

During the study, it was observed that certain additional functions will be required to properly implement the recommendations made for reporting reliability and maintainability data elements. The following recommendations result from these observations:

(1) Guidance manuals should be developed and training programs conducted in two areas, as follows:

(a) Management use of reliability and maintainability data outputs as decision factors equal in importance to cost, schedule, manpower, and equipment performance

(b) Data collection by technicians and maintenance personnel

The latter training should be conducted either as part of technical rating requirements or in the form of courses for proficiency increases.

(2) The Navy should prepare a guide that standardizes data-element terms and definitions for the MDCS (Ships) and MDCS (Aviation) manuals and clarifies the relationships between the data elements in continuing Navy data systems, expiring Navy data systems, data banks, other military data systems such as AFM-66-1 and TAERS, and manufacturer's data systems. The guide would assist analysts, data processors, and technical personnel in applying all the available data.

(3) Computer programs should be developed to provide summary outputs rather than simple lists of information from failure reports. The programs should be designed to allow inclusion of data collected during each of the equipment's life-cycle phases. They should have the following capabilities:

   (a) To automatically retain equipment-identification (bookkeeping) data such as manufacturer, manufacturer's model number, design-change numbers, dates of incorporation of design changes, contract numbers, etc. Such a memory capability will allow many data elements to be reported only once.

   (b) To compute MTBF, MTTR, equipment availability, and the associated summary data required for percentage or trend-change analysis

   (c) To extract computed data by - as a minimum - reporting activity, equipment identification, or failed part identification.

(4) The several continuing operational Navy data-reporting systems, such as CASREPS and OPTEVFOR, should be programmed into the MDCS central data-processing system.

APPENDIX A

CASE STUDIES THAT ILLUSTRATE MANAGEMENT PROBLEMS

APPENDIX A

CASE STUDIES THAT
ILLUSTRATE MANAGEMENT PROBLEMS

CASE 1 - MOTOR, CONDENSATE BOOSTER PUMP

Deficiency:

Insulation failure caused by water in motor - MSO Class 21 Minesweepers.

Originally-Requested Corrective Action:

Increase the stocking allowance to compensate for the high failure rate.

Inspection Recommendation:

Relocate the pump to a higher position.

Interim Solution (brief):

(a) Maintain a condensate suction temperature of 100°F to reduce severe condition and loss of pump suction which causes damage to the pump and motor.

(b) Provide a drainage capability for the condensate booster-pump motor to relieve trapped water.

(c) Keep the forward engine room bilges to a minimum water level to improve the pump's environment. The application of the pump represents a case of marginal design adequacy.

Data Reported:

This problem was identified, and an interim solution obtained, through data reported on NAVSHIPS Form 3621 and special engineering data reports. The reports indicated 79 failures of electric motors from 1 July 1964 through 30 September 1965, of which 13 were caused by winding failures due to water in the motor. The instruction manual states that the pump must be mounted in a place as free as practical from dust and moisture.

Data-Collection Summary:

Data Element	Data Collected		Data Required	Notes
	Form 3621 (1)	MDCS		
Originating Activity	Yes	Yes	Yes	
Known Name	No	Yes	Yes	
Equipment Identification (EIC)	Yes	Yes	Yes	
Serial Number	Yes	No	Yes	(2)
Manufacturer	No	No	Yes	(3)
Date/Time of Failure	Yes	No	Yes	
Operating hours on failed part	Yes	Yes	Yes	
Accumulated operating hours	No	No	Yes	(4)
Descriptive Remarks	Yes	Yes	No	(5)
How malfunctioned	No	No	Yes	(5)
Malfunction Cause	Yes	Yes	Yes	
Operational Condition	Yes	No	Yes	
Maintenance Data	No	Yes	Yes	
Date Maintenance Completed	Yes	Yes	Yes	

Notes:

(1) The Deficiency Evaluation Report indicated that a special investigation was conducted to supplement the data available from the NAVSHIPS 3621 reports. This was necessary for the following reasons:

(a) Accurate identification of the equipment was required to verify that the problem was the condensate booster-pump motor and not the motor for the brine overboard-discharge pump.

(b) A letter report from COMINPAC indicated a detrimental environment for prolonged motor operation.

(c) Indications were that many ships did not report all failures (the thirteen failures were from 7 ships of 61).

(2) Serial numbers aid correlation of failures and indicate multiple failures on a single equipment. The serial number also can be related to modifications incorporated by the contractor or by SHIPALT.

(3) Manufacturer identification provides direction to the proper drawings. In this case, 12 of the 13 motor failures were manufactured by one company.

(4) Total accumulated operating hours (all similar equipments) are necessary to compute mean time between failures. An incorrect answer is obtained if only the operating times on the failed equipments are used to compute MTBF.

(5) In this case, the descriptive remarks may have been used in place of the How Malfunctioned code. However, it is suspected that the malfunction mode was determined by Naval Shipyard investigation.

Conclusion

A review of the available information on this case indicates the following:

(1) Properly reported data elements from all ships would have revealed the problem before it reached the severe magnitude indicated.

(2) Management use of the summary reports would have resulted in an earlier corrective action.

(3) Implementation of the original recommendation could have been costly in both equipment, man-hours, and ship effectiveness. Lowering the level of the bilge water was the final solution used.

CASE 2 - TELETYPEWRITER MODEL

Deficiency:

Multiple complaints on adjustment sensitivity and equipment downtime.

Data Reported:

The problem was reported by special investigations and CASREPS. Indications are that maintenance training, repair-parts support, and design maturity are inadequate, but adequate documentation is not available.

Data Analysis:

Insufficient reliability and maintainability data were available to specifically identify and correct the problem.

Conclusion:

To intelligently consider the cost, technical feasibility of modifications, and projected system effectiveness of the equipment, a lengthy controlled assurance test must be completed and the data analyzed. A special investigation of operational conditions is also indicated to support program-management cost-effectiveness decisions related to future plans for competitive equipments.

Had a history of failure and operating reports been available, the risks associated with the immediately required decisions would have been significantly reduced. Wisely, the program management proceeded with interim actions and established plans for obtaining the required data. Valuable time and dollars were sacrificed in the process.

CASE 3 - CAPACITOR, FIRE CONTROL SYSTEM

Deficiency:

Unsatisfactory system availability due to repair-parts shortage.

Originally-Requested Corrective Action:

Procure additional supplies to improve the support requirements.

Data Reported:

The data obtained from the BuShips 10550 Report System identified the increased use of the capacitor and the shortage of repair parts, but did not indicate the cause of the increased useage or the particular application in the equipment circuitry.

Conclusion:

Technical management could not identify the cause of failure or estimate the frequency of occurrence. The result was an inability to analyze and correct the cause of failure and reduce both the need for the repair parts and the associated maintenance downtime. The immediate task of increasing the supply was also hampered by being unable to make a reasonable estimate of the quantity required. Accurate reporting, including information on the cause of failure, the effect on the system (other parts may be degraded as a result of the failure), the frequency of occurrence as related to system operating time, and the maintenance requirements would have eliminated guesswork and expedited corrective action.

APPENDIX B

APPLICATION OF DATA ELEMENTS IN RELIABILITY AND MAINTAINABILITY COMPUTATIONS

APPENDIX B

APPLICATION OF DATA ELEMENTS IN RELIABILITY AND MAINTAINABILITY COMPUTATIONS

1. General

Table B-1 lists several analytic techniques for preparing information for various levels of management personnel. The corresponding purposes and types of data required are included in the table.

TABLE B-1

ANALYTIC TECHNIQUES FOR DATA PREPARATION

Management Level	Analytic Technique	Output Purpose	Data Elements
Ship or Station	· Comparison of Means · Error Analysis · Control Charts · Sequential Sampling	· Manning Limitations · System and Material Allocations · Policy Requirements · Schedule Requirements	· Equipment Operating Time Maintenance Man-Hours (Active and Inactive) · Calendar Downtime · Equipment Failures · Part Replacements/Source · Number of Maintenance Actions · Technician Class · Number and Type of *Operations/Missions*
Operations and Bureaus	· Tests of Significance · Analysis of Variance · Regression and Correlation	· Mission Effectiveness · System Effectiveness · Schedules Requirements · Policy Requirements	· Equipment Operating · Equipment Downtime · Active Repair Time (Clock/Man-Hours) · Equipment Failures · Failure Modes · Failure Effect · Number of Operations/ Missions · Number of Successes · Environment · Equipment Identification
Bureaus and Material Commands	· Analysis of Variance · Mathematical Modeling · Sensitivity Testing Simulation	· Malfunction Analysis · Critical Item Analysis · Supportability Analysis · Performance Analysis	· Equipment Failures · Equipment Downtime · Equipment Operating Time · Active Repair Time (Clock/Man-Hours) · Failure Mode · Failure Effect · How Discovered/Symptoms · Failure Verification · Equipment Replacements · Spares Source · Number of Operations/ Missions · Number of Successes · Environmental Conditions · Equipment Identification
SPO, Projects, and Laboratory	· All the above plus special techniques such as information theory and human factors analyses	· Contractual Compliance · Specification Development · Distribution Characteristics · Acceptance Criteria · Test Requirements · Environmental Limitations · Predictions · Development Schedules · Trade-off Constraints	· All valid data elements past and present

2. Application of Data Elements in Reliability Computations

2.1 Equations

2.1.1 The General Reliability Expression

$$R(t) = e^{-\int_0^t \lambda(x)dx} \quad \text{or} \quad e^{-\int_0^c \lambda(x)dx}$$

= Probability of completing a given mission of time (t) or cycles (c) without a malfunction

where

$\lambda(x)$ = the function describing the instantaneous failure rate over the mission time or cycle requirements.

> Data-element inputs:
>
> - Malfunction reports
> - Total operating time (includes time on equipments without failures)
> - Equipment identification

2.1.2 The Exponential Distribution

$$R(t) = e^{-\frac{t}{MTBF}}$$ = Probability of completing a given mission of time (t) without a malfunction

where

$$MTBF = \frac{\text{Total Equipment Operating Time}}{\text{Total Number of Failures}}$$

> Data-element inputs:
>
> - Malfunction reports
> - Total operating time (includes time on equipments without failures)
> - Equipment Part Number and Serial Number

2.1.3 The Normal Distribution

$$R(t) = \int_t^\infty \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(t-MTBF)^2}{2\sigma^2}}$$

If there are no censored observations, the parameters are estimated by:

$$\sigma^2 = \sum_{i=1}^{N} \frac{(t_i - MTBF)^2}{N-1}$$

where

$$MTBF = \frac{\text{Total Equipment Operating Time}}{\text{Total Number of Failures}}$$

t_i = The operating time for each failure

Data-element inputs:

- Malfunction reports
- Operating time at failure
- Total operating time (includes time on equipments without failures)

For censored data refer to ARINC Research Corporation's Reliability Engineering Text, pages 149-154.

2.2 Prediction Methods

Example:

In a simple communications system comprising a transmitter, a receiver, and a coder, the failure of any one of these three elements will make two-way communication impossible.

During a required 8-hour communication period, the element reliabilities for their individual operating periods are as follows:

Transmitter (6-hour operation), $R_1 = 0.85$

Receiver (8-hour operation), $R_2 = 0.99$

Coder (4-hour operation), $R_3 = 0.94$

2.2.1 The Product Rule

The combined reliability of the simple series configuration is the product of the individual reliabilities, since a failure of any one element constitutes a system failure:

$$R_{system} = R_1 \times R_2 \times R_3 \ldots\ldots\ldots R_i$$

where R_1, R_2, R_3, R_i are the individual element probabilities of of survival for the required operating time.

Therefore, the reliability for the example system, for an eight-hour period, is

$$R_{system} = R_1 \times R_2 \times R_3 = 0.85 \times 0.99 \times 0.94 = 0.79$$

2.2.2 The Summation Rule and the Exponential Equation

If a constant failure rate is assumed, the combined failure rate of the simple series configuration is equal to the sum of the individual failure rates:

$$\lambda_1 + \lambda_2 + \lambda_3 = \lambda_{system}$$

Therefore, the failure rate for the example system is as follows:

$$0.16 + 0.01 + 0.06 = 0.23 \text{ system failures per 8 hours of operation}$$

and

$$R_{system} = e^{-\lambda t} = e^{-0.23} = 0.795 \quad .$$

2.2.3 Effect of Redundancy

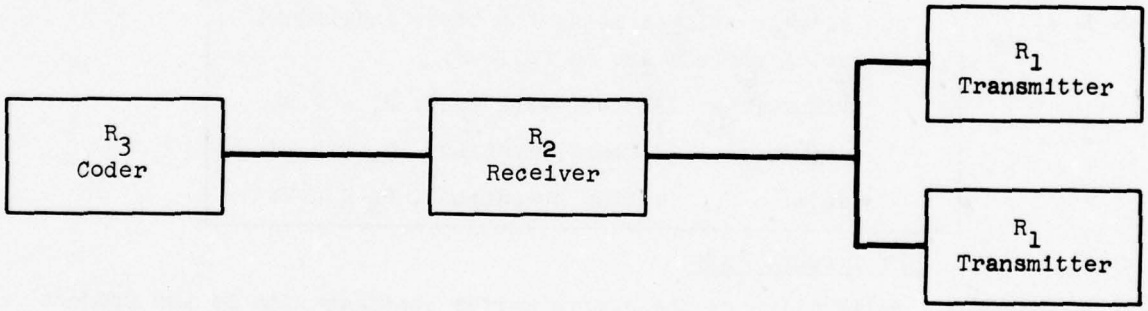
If a redundant transmitter is added to the example system as shown in the diagram below, the reliability of the transmitter section is

$$R_{1,1} = 1 - (1-R_1)\ (1-R_1)$$

$$R_{1,1} = 1 - (1-0.85)^2 = 0.9775.$$

The system reliability, then, is,

$$R_{system} = 0.9775 \times 0.99 \times 0.94 = 0.9097$$



3. Application of Data Elements in Maintainability Computations

3.1 Equations

3.1.1 Mean Time to Repair

$$MTTR = \frac{\sum_{1}^{N} \text{Active Repair Time}}{N}$$

where

N = Number of Repairs

Data-element inputs:

- Equipment repairs
- Active repair calendar time for each repair
- Equipment identification
- Rate and specialty of technician

3.1.2 Maintainability Index [Per MIL-M-23313A (Ships)]

$$\text{Log MTTR}_G = \frac{\sum_{i=1}^{20} (\text{Log Repair Time})}{20}$$

where

20 = the number of repair samples specified

Log MTTR_G = Log of geometric mean-time-to-repair

The following expression must also be satisfied:

$$\text{Log MTTR}_G < \log \text{ERT} + 0.397\ (S)$$

where

Log ERT = Log of specified equipment repair time

S = Standard deviation of logarithms of adjusted repair times

$$= \frac{\sum_{i=1}^{20} (\text{Log Repair Time})^2 - (\text{Log MTTR}_G)^2}{20}$$

3.1.3 Equipment Availability

$$\text{Availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}} = A$$

$$A_{\text{Intrinsic}} = \frac{\text{Total Operating Time}}{\text{Total Operating Time} + \text{Total Active Repair Time}}$$

3.1.4 Maintenance Support Index

$$\text{MSI} = \frac{\text{Active Repair Man-Hours Per 1000 Equipment Operating Hours}}{\text{Total Operating Time}}$$

Data-element inputs:

- Active repair man-hours for each repair
- Total equipment operating time

4. Comparison of Current and Potential Uses of Data

Figure B-1 illustrates a current output from a Navy data-feedback system. It considers five specific equipment types and presents the maintenance man-hours expended on each during the reporting period as a percentage of the sum of the hours. These facts are of little value to management. Figure B-2 illustrates the useful, detailed information that could be derived for each equipment type if additional data-elements, as recommended in this report, were collected.

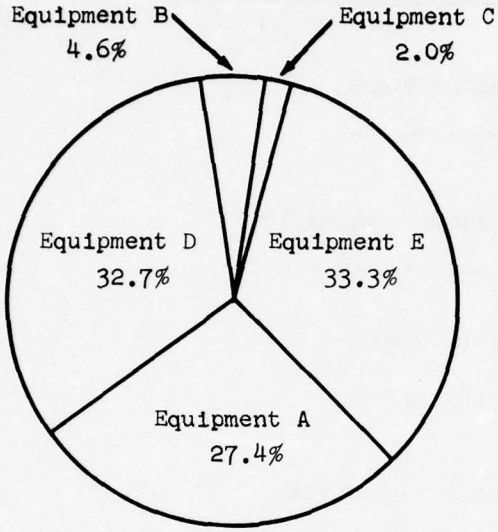


FIGURE B-1
DISTRIBUTION OF TOTAL MAINTENANCE MAN-HOURS FOR FIVE EQUIPMENT TYPES

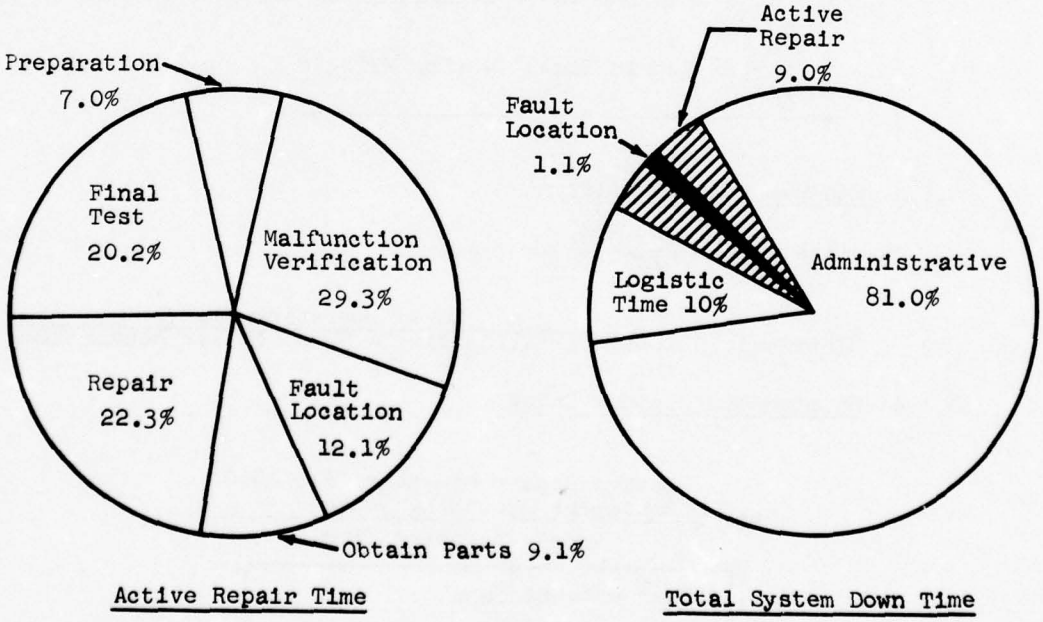


FIGURE B-2
DISTRIBUTIONS OF MAINTENANCE TIMES FOR A SPECIFIC EQUIPMENT

APPENDIX C

TABULATION OF RELIABILITY AND MAINTAINABILITY DATA ELEMENTS BEING COLLECTED BY MILITARY AND CIVILIAN ACTIVITIES

TABLE C-1

RELIABILITY AND MAINTAINABILITY DATA ELEMENTS

Data Elements	Military: Navy: Current and Continuing: 3M - MDCS: Ships: Man-Hour Accounting	Intermediate Maintenance Planning and Control Form	Requisition Card (For Mechanized Ships)	Issue/Turn in Document (For Nonmechanized Ships)	Accounting Machine Cards for Man-Hour Accounting	Aviation: Organizational Maintenance Control Register	Organizational Work Center Register	Intermediate Maintenance Register	COTF C/S11	Operating Time Log	FARADA	ARMMS	MDC U. of Pa.	CASREP	MEAR	* Philadelphia Ship-Yard	Expiring: BuShips	Electronic Performance and Operational Report	BuWeps	SAM Fleet FSO-1-R-001	Shipboard Weapon System Equipment Elapsed Time Meter Report	Air Force AF-66-1	Army TM 38-570	Contractors: Martin Marietta	Borg Warner	Honeywell	G. E.
	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	17 18	19 20	21	22	23	24	25	26 27 28 29	30	31	32	33 34	35 36	37 38 39	40	41	42	43
BOOKKEEPING																											
Ship Name, Hull Name, Bureau No., Type Station, Activity, Originator	o o o																										
Repair Activity, Work Center, Maintenance Level, Action Organization	o o o																										
Maintenance Control No., Job Control No., Report Serial No., Ship Account No.	o o o																										
FSN, Bureau Plan and Piece No.																											
Identification or Code (System/Equipment)	o o o																										
S/N (System/Set/Equipment/Engine)	o o o																										
Manufacturer of System (Name/Code)																											
Contacts (Name, Rate, No.)																											
Identification or Code (Assembly/Component	o o o																										
Manufacturer Name or Code (Assembly/Component)																											
Manufacturer P/N (Unit/Component/Accessory/Equipment)																											
S/N (Unit/Component/Accessory/Assembly/Equipment)																											
Nomenclature (Subassembly/Primary Part)	o o o																										
Manufacturer P/N (Primary Failed Part)																											
S/N (LDU/Subassembly)																											
Manufacturer Name or Code (removed item)																											
Circuit Symbol/Reference Designator	o o o																										
P/N (removed item)																											
S/N (removed item)																											
FSN (removed item)																											
Manufacturer Name or Code (Component/Assembly Replacements)																											
Manufacturer Name or Code (Installed Item)																											
P/N (Installed Item)	o o																										
S/N (Installed Item)																											
Signature: Commanding Officer	o																										
Signature: Supervisor	o o o																										
Signature: Inspector	o																										
Signature: Repairman and Specialty	o o o																										
Signature: Person Reporting																											
FSN (returned item)																											
Location (Geographic)																											
Location (Physical)																											
Work Unit Code																											
CID/APL/AN Number	o o o																										
Unit Price	o o																										
Production Status																											
Failure Reporting System																											
Configuration Control																											

*Proposed

(continued)

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TABLE C-1 (continued)

Data Elements	Military																																Contractors					
	Navy																																Air Force		Army					
	Current and Continuing																						Expiring															
	3M - MDCS																																					
	Ships								Aviation																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
BOOKKEEPING (continued)																																										
Equipment Contractor																							□														☎					☎	
Assisting Work Center	○	○																															X										
Installed in A/C Arresting Gear, Catapult, or Support Equipment (Model Design, and Bureau No.)																														□												
TIME, CYCLE AND DATE																																									
Date form submitted														□					□		□	□	□		□			△			□										□		
Date/Time Failure																	□									□	□			□	□			△			□	□		□	□		
Date/Time Maintenance began									□	□						□	□				□												□	△		□					□		
Total System/Equipment Operating Time																					□			□	□								□				□	□				□	□
Time since new (Vintage of Equipment/year of operating status)																			□									□		□			□	△									
Operating Hours on Failed Part	○	○	○																△	△				△		△		□						△									
Time Meter Readings (Logbook Time/Malfunction Equipment)	○	○	○						X	X							△						△				X			X	X										▲		
Operating hours since last component failure																					□					□																	
Date of last failure																										□																	
Total No. of Launches - Starts or Landings since new																								△						□												
Miles																																			□	□						
Rounds or Starts																																			□	□						
System Mean Time (Total no. of failures)																			□																								
Date and Duration of Test																			□					□																			
Estimated Active Repair Time (man-hours)																																	□									
Maintenance Time-Total Man-Hours	○	○	○						X	X														△									X									X	
Maintenance Time - Diagnosis																	□				□									□				□			□						
Maintenance Time - Active Repair																	□							□						□				□									
Maintenance Time - Active Repair (incl. diagnosis)																	□				□													□									
Maintenance Time - Delay																	□				□																						
Logistics and Admen Time																									□												□						
Date/Time Maintenance completed	○	○	○						X	X				△	△		△				△					X	△										X					X	
Maintenance Time - Total active clock hours																	□						□	□			□			□							□					
Maintenance Time - Daignosis																	□				□				□							□					□	□				
Maintenance Time - Active Repair																	□				□				□							□					□	▣				
Maintenance Time - Technical Directives															□																											
Maintenance Time - Delay																	□																				□					
Date Inspected																																										
Scheduled Start Date			○																					△									▲									
Desired Completion Date			○						X	X						△								△																		
Dated Ordered (TD Kit)															□																											
Date Received (TD Kit)															□																											
Elapsed Maintenance time to incorporate ID									□	□														□																		
Maintainability Time (exclusive of idle time)																								□																		

Intermediate Maintenance Planning and Control Form
Requisition Card (For Mechanized Ships)
Issue/Turn in Document (For Nonmechanized ships)
Accounting Machine Cards for Man-Hour Accounting
Man-Hour Accounting
Organizational Maintenance Control Register
Organizational Work Center Register
Intermediate Maintenance Register
Operating Time Log
Electronic Performance and Operational Report
Shipboard Weapon System Equipment Elapsed Time Meter Report

*Proposed

(continued)

TABLE C-1 (continued)

Data Elements	Military																																Contractors					
	Navy																																					
	Current and Continuing																							Expiring														
	3M - MDCS																																Air Force		Army				
	Ships							Aviation								COTF C/S41		F A R A D A	A R M M S	MDC U. of Pa.	C A S R E P	M E A R	* Phila-delphia Ship-Yard	BuShips				BuWeps		SAM Fleet FSO-1-R -001		AF 66-1		TM 38-570		Martin Marietta		Borg Warner	Honey-well	G.	E.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
TIME, CYCLE AND DATE (continued)																																										
Equipment Downtime	o	o	o																					Δ	Δ					Δ	X										
Scheduled Maintenance (time required for daily maintenance)																								□																	
Unscheduled Maintenance (mean elasped time)																								□																	
Equipment Availability (Days)																								□																	
TECHNICAL SUPPORT																																									
Failed Material (action code)									□	□									□									Δ													
No. of Failures (each mode)																	□		□	□														Δ						□	
No. of Failures (each part)																																		Δ							
Failed Material (quantity)																																	□				□			□		
Units (no. on which maintenance performed)	o	o	o						Δ	Δ					Δ									Δ				X					X	Δ					Δ			
Total Systems (number)																			□			□																			
Quantity (No. of items received or returned)	o	o																				Δ						X		Δ				X	Δ	Δ	Δ	Δ	□		
Items Processed (number)									□	□				□			□																						□		
Estimated percent of total failures reported																			□																				Δ		
Failure rate																				□				□															□		
Part/Component Population																				□																			□		
Symptoms (Description of failure and discovery)																											□			□	□				□				□	□	
Malfunction Description									□	□									□				□										□			□	□		□		□	
Description/Remarks (additional information)	o	o	o												X		X		X		X	Δ		Δ	Δ	X	X			X	X				Δ	Δ	Δ	Δ		Δ	Δ	Δ	
Reason Code																□																										
Maintenance required as a result of																														□				□						□	
Part condition (failed part)																														□				□							
Malfunction/failure cause	o	o	o														X				X		X	X		X	X			X	X			□			X	X		X		
Failure Code	o	o	o																Δ						Δ					□	Δ				Δ	Δ						
How malfunction (PM or Repair Required)	o	o	o						X	X																							X									
Equipment status after failure																							□	□	□						□		□								
Type of failure (critical/major/minor)																	□								□		□												□		□
Operational Condition																										□	□							X					X		
Discovered (Code/Time/Situation)	o	o	o						X	X					Δ										Δ					Δ	Δ		X	X	Δ	Δ			□	Δ		
Status of Equipment															□																			X								
Intended Use																				□														□								
Environment																			□	□					□														□			
Special Environmental Conditions																			□	□																			□			
Percent of rating (voltage/power, etc.)																				□																				□		
Disposition of removed item									□	□																	□									□			□		□	
Part Replacement Code																	□										□				□					□			□			
Source Code	o	o																							□																	
Required Material (quantity)	o	o							Δ	Δ															Δ																	
Material of which part is made																										□																

Operating Time Log

Electronic Performance and Operational Report

Shipboard Weapon System Equipment Elapsed Time Meter Report

*Proposed

(continued)

TABLE C-1 (continued)

Data Elements	Military																																			Contractors					
	Navy																																									
	Current and Continuing																									Expiring															
	3M - MDCS															COTF C/S41		FARADA	ARMMS	MDC U. of Pa.	CASREP	MEAR	Philadelphia Shipyard *	BuShips				BuWeps		SAM Fleet FSO-1-R-001		Air Force AF 66-1		Army TM 38-570		Martin Marietta		Borg Warner	Honeywell	G. E.	
	Ships							Aviation																																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
TECHNICAL SUPPORT (continued)				Man-Hour Accounting	Intermediate Maintenance Planning and Control Form	Requisition Card (For Mechanized Ships)	Issue/Turn in Document (For Nonmechanized Ships)	Accounting Machine Cards for Man-Hour Accounting			Organizational Maintenance Control Register	Organizational Work Center Register	Intermediate Maintenance Register				Operating Time Log									Electronic Performance and Operational Report					Shipboard Weapon System Equipment Elapsed Time Meter Report													
Kit Required															□																											
Material/Kit Stock No.															□																		□									□	
Material/Kit (No. of items required)															□																											
Part Availability																	□										□								□								
Type of Availability			O																																							
Support Equipment Required															□						□																					
Support Code														□																												
Action Taken (Repair/Replace/Modify/Adjust/Remove)								□	□							□															□						□	□		□	□		
Action Taken (Code)	O	O	O					X	X															X							□		△	△								
Status of Action															□									□							□	□										
Disposition of Action (Narrative)								□	□																						□						□	□		□			
Identification of test or activity in Progress																				□																	□		□		□	□	□
Reference Documents (Specifications/Reports)																			□		□	□	□	□														□			□	□	
Interim Directives															□																											
Items Processed (No. of times corrective actions taken on work unit code)																								□																		
Type of Maintenance								□	□					□			□		□												□										
Type o. Report																											□										□				□	
Report Priority															□															□		□	□		□						
Service Code			O																		X																				
No. of Maintenance checks since last failure																										□															
Previous Maintenance Event (yes or no)																															□										
Code of equipment after maintenance																															□										
Special (Note frequent trouble item)																														□											
Accessibility (Serviceability)																														□					□						
Crew Size															□																											
Compliance (TD) Recorded															□																											

*Proposed

TABLE C- 2

EXPLANATION OF COLUMN-HEADING NUMBERS USED IN TABLE 1

1. OPNAV 4700-2B
2. OPNAV 4700-2D
3. OPNAV 4700-2C
4. OPNAV 4700-2E
5. OPNAV 4700-2F
6. DD-1348
7. NAVSANDA 1250
8. MMMPC Form No. 1
9. MMMPC Form No. 4
10. MMMPC Form No. 5
11. MMMPC Form No. 6
12. MMMPC Form No. 7
13. MMMPC Form No. 9
14. MMMPC Form No. 10
15. MMMPC Form No. 11
16. MMMPC Form No. 12
17. Material Maintenance Record
18. Operating Time Log
19. 77ND-FMSAEG-8800-9
20. 77ND-MFSAEG-8800-10
21. Individual Record of Corrective Action
22. Monitor Data System
23. Navy Casaulty Report
24. Exhibits IB-XIII
25. Failure/Malfunction Report
26. 9120-1 (NAVSHIPS 3621)
27. 10550-1 (NAVSHIPS DD-787)
28. 10550-1 (NAVSHIPS 4855)
29. 9670-1 (NAVSHIPS 3878)
30. 13070/3
31. 8000-13
32. 8000-23
33. AFTO 210 and 211
34. AFTO 212
35. 2408-3
36. 2407
37. MARS R 16507
38. DEN 066414
39. DEN 066124
40. Failure Report
41. R-ED 25078
42. DCS/NCR Form RS-1168
43. COTA Form RS-1575

TABLE C-3

EXPLANATION OF SYMBOLS USED IN TABLE 1

- O Data elements contained in the MDCS Surface Reporting System
- Δ Similar data elements contained in other reporting
- X Similar data elements contained in other reporting systems but described differently in the MDCS Surface System
- □ Data elements contained in other reporting systems but not in the MDCS Surface System

APPENDIX D

RELIABILITY AND MAINTAINABILITY DATA-FEEDBACK SYSTEMS AT NAVAL SHIPYARDS

APPENDIX D

RELIABILITY AND MAINTAINABILITY DATA-FEEDBACK SYSTEMS AT NAVAL SHIPYARDS

General

The material in this Appendix is presented as received from Mr. C.T.G. Murphy, Code 1820, Philadelphia Naval Shipyard. It comprises the following sections:

(1) List of Data Elements

(2) System/Equipment Utilization Log

(3) System Description Sheet

(4) Failure Reporting and Data Feedback Systems in Shipyards and Laboratories.

LIST OF DATA ELEMENTS 7 April 1966

In order to perform Reliability and Maintainability engineering analysis based on field failure reporting in the shipyards, certain data elements must be collected. The recommended failure/malfunction reporting form to be implemented in shipyards is shown in Figure I. The information required to complete the form will provide sufficient data to enable engineering analysis in the areas of Reliability and Maintainability. The required data to complete this form and the use of this data is as follows:

Block 1 SHIP NAME, CLASS AND HULL NO. - If the equipment being repaired is assigned to a ship indicate which ship, e.g. U.S.S. Buck, DD761, otherwise indicate supply activity, training activity, shop activity, etc. This will enable a continuous failure history of the equipment for each ship/activity (this information will be fed into the 3M data processing systems.)

Block 2 DATE, MONTH, YEAR - Indicate data failure occured; e.g. 28 day; 07 month; and 6 for 1966. This will enable the chronological ordering of failure data so that the number of failures for a given time period may be determined for failure rate and mean-time-between-failure calculations.

Block 3 REPORT NUMBER - This is a preprinted number on each form. This report number will be used to identify and control the report.

Block 4 REPAIR ACTIVITY - Designate which repair activity is performing the corrective action, e.g. Philadelphia NSY. This will identify the activity submitting the report in case follow-up action is necessary.

ENCL (1)

FAILURE/MALFUNCTION REPORT

1. Ship Name, Class and Hull No.	2. Date Month Year	3. Report No.
USS BUCK DD761	28 | 07 | 6	AK7001

4. Repair Activity	5. Work Center	6. Equip. I.D. Code	7. Serial No. & Mfr.	8. How Mal. Code
PHILA. N.S.Y	390/51	FE04303		

9. Primary or Secondary	10. Disc	11. Status After Failure	12. Environment
		A3 32 C1	

13. Active Repair Time						14. Log Downtime	15. AD Downtime
13a. TI	TD	TINT	TR	TA	TC		

16. Total Equip. Downtime	17. Total Op. Time	18. Serial No. & Mfr. of Replacement

19. Narrative Remarks & Recommendations

20. CID/APL/AN

21. Source Code	22. Federal Stock No./Part No.	23. Reference Symbol/Noun	24. Material Used Units	24. Material Used Quanity	25. Unit Price

26. Sig. of Supply Pers.	27. Sig. of Repairman	28. Sig. of Repairman Supt.

Figure I

Block 5 WORK CENTER - Indicate the repair activity work center performing the work, e.g., 390-51. This will identify the goup responsible for the work in case follow-up action is necessary.

Block 6 EQUIPMENT ID CODE - This seven-digit alpha numeric sequence is found in the Equipment Identification Code Manual. When a part is replaced the EIC digits will be provided by the individual issuing the replacement parts. When the corrective action is a result of misalignment or adjustment and no replacement parts are involved and the Equipment Identification Code Manual is not available, then sufficient information must be provided within the narrative remarks section to completely localize the problem area e.g.

(a) Communications system Serial No. _____
Mfr. _____.

(b) Infrared set, AN/SAR-6 Serial No. _____
Mfr. _____.

(c) Receiver Assembly Serial No. _____
Mfr. _____.

(d) Tuned transistor OSC Serial No. _____
Mfr. _____.

In the case where a transistor is replaced in the oscillator, the following information (FEO 4303) would be provided by supply personnel where in accordance with the Equipment Identification Code Manual

F = Communications and computer systems

FE = Comlunications, infrared system

FE04 = Infrared Set, AN/SAR-6

FE043 = Receiver assembly

FE04303 = Transistor oscillator

The Equipment Identification Code will be used to identify the

(1) System

(2) Set

(3) Assembly

(4) SubAssembly

(5) Part

Block 7 SERIAL NO. & MFR - Indicate the manufacturer and the serial number of the lowest set, assembly or subassembly that contains the failure and has a nameplate. In the above example if there is a name plate attached to the receiver the manufacturer and the serial number would be written in block 7. If there is no name plate attached then the serial number and manufacturer of the AN/SAR-6 set would be written in block 7. This information would identify the individual piece of equipment that failed and the manufacturer.

Block 8 HOW MAL CODE - Use the three digit code from Section IV of the EIC Manual which best describes the failure listed in Block 6 or the part data.

This will aid the analyst in isolating the failure and determining the cause. It will also provide

information for troubleshooting charts in the technical manuals.

Block 9 PRIMARY OR SECONDARY - Indicate whether the failure was a random type failure (P in Block 9) or secondary type failure (S in Block 9) that was caused by another failure or action.

This will aid the analyst in screening out all but the primary failures used in calculating the failure rate.

Block 10 DISCOVERED - Enter the appropriate code that best identifies when the equipment malfunction was discovered.

Code	Description
A	When lighting off/starting
B	When securing
C	During Equipment operation
D	During Preventive Maintenance
E	Special Instruction (INSUR or other requirements specified by Tech Bureaus)
F	Underwater hull inspections
G	During corrective maintenance
H	Incoming inspection
J	Test
K	During installation

This will aid the analyst in determining the cause of the failure and the corrective action.

Block 11 STATUS AT FAILURE - Indicate how the system, set, assembly reacted to the failure using the following code:

Code	Description
A	System
B	Set
C	Assembly
1	Inoperative
2	Operating at reduced capability
3	Operation unaffected

e.g. A3-system operation unaffected

B2-set operating at a reduced capability

C1-assembly inoperative

This will aid the analyst in determining how the system, set, and assembly reacts when a failure occurs. It will also aid in determining whether modification is justified to improve the availability of the system. This information is also needed for system, set and assembly MTBF and availability calculations.

Block 12 USE ENVIRONMENT AT FAILURE - Indicate whether the environment at the time of failure was normal or abnormal. If normal put a N in block 13, if abnormal put an X in block 13. If an X is put in block 13 describe the conditions in the remarks section. This information must be obtained from the personnel using the equipment.

This will aid in determining the cause of the failure and identify unusual environmental conditions that may be contributing to failures.

Block 13 ACTIVE REPAIR TIME - Write in total hours to the nearest tenth.

Block 13a - Write in hours to the nearest tenth required to:

TI - Time to isolate failure

TD - Time to disassemble

TINT - Time to interchange

TR - Time to reassemble

TA - Time to perform alignment

TC - Time to checkout

This will provide detailed information for the analysis of long corrective maintenance times and for calculating mean-time-to-repair.

Block 14 LOGISTICS DOWTIME - Indicate the downtime in hours to the nearest tenth required to obtain replacement items. This will provide equipment downtime due to logistics and will enable supply personnel to evaluate and improve their present method of providing replacement items.

Block 15 ADMINISTRATIVE DOWNTIME - Indicate in hours to the nearest tenth the time lost due to adminstrative downtime. Administrative downtime is any time, exclusive of logistics downtime, not expended in an effort to correct the problem, e.g. lunch, performing another job, completion of workday, etc.

Block 16 TOTAL EQUIPMENT DOWNTIME - Indicate the total number of hours to the nearest tenth the equipment was not operating due to active repair time and logistics and administrative downtime. This information will

provide the time base for calculating inherent and operational mean-time-to-repair on system, sets, and assemblies.

For given period of time:

$$\text{MTTR operational} = \frac{\text{Total Equipment Downtime}}{\text{Total number of failures}}$$

Total Equipment DownTime = Total Active Repair time + Total Administrative DownTime + Total Logistics DownTime

$$\text{MTTR inherent} = \frac{\text{Total Active Repair Time}}{\text{Total number of failures}}$$

Block 17 TOTAL OPERATIONAL TIME - Indicate the total number of hours the equipment has operated. This information will be obtained from Operational Time Logs, from Elapsed Time Indicators or from using personnel if known by them.

This will provide data that can be used to determine distribution and to calculate operational and inherent mean-time-between-time failures.

For given period of time:

$$\text{MTBF operational} = \frac{\text{total operating time}}{\text{total no. of failures}}$$

$$\text{MTBF inherent} = \frac{\text{Total operating time}}{\text{Total number of primary failures}}$$

Where primary failures are random failures that exclude human error, design, manufacturing defects, etc.

Block 18 SERIAL NO. & MFR. OF REPLACEMENT ITEM - If the failed item was replaced indicate the serial number and manufacturer of the replacement item. This data will enable the analyst to determine which equipment

are operating in the systems.

Block 19 NARRATIVE REMARKS & RECOMMENDATIONS - Use this space for clarification and recommendations.

This will provide amplifying data which can be used by the analyst to identify unusual circumstances, provide clarification beyond the scope of the coded data elements and justify engineering change recommendations.

Block 20 CID/APL/AN - This information will be filled in by maintenance personnal whenever possible. If maintenance personnel are unable to identify this number correctly it will be filled in by supply personnel. The Component Identification (CID), Allowance Parts List (APL), or Army-Navy (AN) numbers identify the equipment or component in which the repairs parts or material were consumed.

Block 21 SOURCE CODE - To be filled in by maintenance personnel from the source code listed in Section VIII, EIC Manual. If the repair man does not have access to the EIC Manual, the information will be provided by supply personnel. This will enable the analyst to determine where the replacement part was obtained (Stock, Salvage, Cannibalization, etc.).

Block 22 FEDERAL STOCK NO./PART NO. - Maintenance personnel will fill in the Federal Stock Number and/or the Manufacturers Part Number of the material used in the maintenance transaction. The Federal Stock Number is preferred. Part numbers will be cross-referenced

to Federal Stock Numbers whenever possible. When part numbers are reported, they must be prefixed by the five-digit Federal Supply Code for manufacturer (FSCM) which identifies the manufacturer of the part. Supply will assist maintenance personnel in obtaining these numbers. This information will enable the analyst to determine if a particular part is failing excessively and if these failures can be traced to one manufacturer.

Block 23 REFERENCE SYMBOL/NOUN - The reference symbol will be used where possible and the noun same in instances where there is no reference symbol; e.g. mechanical parts. Electronic parts will be identified by entry of the appropriate circuit symbol designator. The reference symbol may be determined from the applicable schematic, cirbuit diagrams, illustrated parts breakdown, technical manual, etc. This will aid the analyst in establishing the specific item that failed.

Block 24 MATERIAL USED - Indicate the units of the replacement part and the quantity of replacement parts needed. This will aid the analyst in determining the number of replacement parts used and the cost of the maintenance action.

Block 25 UNIT PRICE - Enter the unit price of the replacement part. This data will help in determining the cost of the maintenance action, and whether a modification is

warrented when evaluating reliability, maintainability, cost and logistics.

Block 26 SIGNATURE OF SUPPLY PERSONNEL - The individual issuing the replacement items provides the specified data and signs the form. A Failure/Malfunction Report must be initiated by the repairman before the stock room issues any replacement items.

This will help to control the reporting of failures and identify the individual issuing the replacement items in case follow-up action is necessary.

Block 27 SIGNATURE OF REPAIRMAN - Enter the name of the person who performed the corrective maintenance action.

This will identify the respondible individual in case follow-up action is necessary.

Block 28 SIGNATURE OF SUPT. - The Supervisor of the repairman signs the form indicating that the information is correct and the form incomplete.

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SYSTEM/EQUIPMENT UTILIZATION LOG

The System/Equipment Utilization Log, Figure I, is a daily log where each incident that occurs is recorded and explained. This log will provide a complete history during test and operation. The information contained on this log will enable an analyst to determine

1. operating time
2. corrective maintenance time
3. preventive maintenance time
4. idle time

The above information is necessary in test report preparation, equipment demonstration and calculating the availability of the systems. It will also aid in determining the effectiveness of the system.

ENCL. (2)

SYSTEM/EQUIPMENT UTILIZATION LOG

1. SYSTEM/EQUIPMENT-NOUN, NAME, & CID/APL/AN						2. DATE(DAY MONTH YEAR	3. PAGE NO	4. PRECEEDING PAGE
5 CLOCK TIME		6. TOTAL ELAPSED TIME THIS OPERATION	7. USING ACTIVITY	8. USE CODE	9. FAILURE REPORT NO	10. START ETI	11. FINISH ETI	12. OPERATORS LAST NAME
START	STOP					13. MAINTENANCE ACTION AND REMARKS		
0000	0330	3-30	CSD	F		Normal operation		Jones
0330	0830	5-00	CSD		AK100	C.M. - Replaced bearings IN drive Motor		Jones
0800						Shift change - System down		Clark
0830	0835	0-05	CSD			System checkout - O.K.		Clark
0835	1535	7-00	CSD			Normal operation		Clark
1535	1600	0-25	CSD			Secured system to take temp. reading		Clark
1600						Shift Change - System O.K.		Brown
1600	2200	4-00	CSD			Normal operation		Brown
2200	2400	2-00	CSD			Equipment Down - Preventitive Maintenance		Brown

Block 1, SYSTEM/EQUIPMENT NOUN NAME AND CID/APL/AN - This information will be filled in by operations personnel.

Block 2, DATE - Enter the day, month, year the equipment/system is being operated. Each form covers only a 24-hour period.

Block 3 PAGE NO. - This is a preprinted sequencial number.

Block 4, PRECEDING PAGE NO. - Enter the preceding page number of the completed log. This will enable the analyst to determine if pages are missing if more than one log is needed each day, or if the number was skipped on purpose.

Block 5, START TIME - Enter the clock time the operations started.

STOP TIME - Enter the clock time the operation stopped for any reason.

Block 6, TOTAL ELAPSED TIME THIS OPERATION - Enter the hours and minutes elapsed during this operation.

Block 7, USING ACTIVITY - Enter the code number or name of the activity performing the operation e.g. CSD, shop 51, ship personnel, etc.

Block 8, USE CODE - Enter one of the codes listed below. If code "g" is entered, explain in the remarks section.

A. Life test

B. Environmental test

C. Installation checkout

D. Routine checkout

E. Normal operation

F. Sea trials

G. Other

Block 9, FAILURE REPORT NO. - Enter the failure report no. if this incident was due to a failure.

Block 10, START ETI - If the equipment contains an elapsed time indication record the reading in Block 11. This reading should be taken at the beginning of the operation or if the operation is conuous, the reading should be taken at 0000 hours when the utilization log is started for that day.

Block 11, FINISH ETI - The finish elapsed time indication reading should be entered at the completion of the operation or at 2400 hours when the utilization log is completed for that day.

Block 12, OPERATORS LAST NAME - The operator that is responsible for the equipment at the time of the incident should enter his last name in Block 13.

Block 13, MAINTENANCE ACTION AND REMARKS - Explain all incident that occur including operational errors as well as maintenance.

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System Description Sheet

The System Description Sheet in addition to the System/Equipment Utilization Log and the Failure Reports, will enable the analyst to determine:

1. What equipments make-up the systems.
2. What constitutes a systems, subsystem, or equipment failure.
3. Inherent and operational MTBF, MTTR, and availability for the equipment subsystem and system.

The System Description Sheet should be completed by the operator prior to beginning the test or operation. This sheet is required only once for each system.

Block 1 Noun Description - Enter the description of the systems, subsystems, and equipment. e.g. Radar systems, tracking radar No. 1 and 2 are subsystems, each tracking radar is made up of an antenna and pedestal, 2 transmitters, a receiver and a display.

Block 2 Model No. - Enter the model number of each of the items listed in block 1.

Block 3 Serial No. - Enter the serial number of each of the items listed in block 1.

Block 4 No. of Modes of Operation - Indicate the number of modes of operation of the system by crossing out the appropriate number.

e.g. If the system operates in both the scan and track modes cross out 2. Indicate which subsystems and equipments are required to perform the mission by placing an X under the mode in which the equipment is used.

e.g. If both trackers must be operating to have acceptable operation place an X in each mode. If all equipment are necessary for normal operation except the transmitter, indicate the condition in the

ENCL (3)

remarks column.

e.g. 1 of 2 transmitters in each mode.

Block 5 Remarks - If more than 1 mode of operation is normal define which block represents which mode. e.g. Number 1 in block 4 represents the scan mode. Number 2 represents the track mode.

SYSTEM DESCRIPTION SHEET

EQUIPMENT UTILIZATION
LOG PAGE Nº _____

SYSTEM	1. NOUN DESCRIPTION	2. MODEL Nº	3. SERIAL Nº	4. Nº OF MODES OF OPERATION (INDICATE WHICH EQUIP IS REQUIRED IN EACH MODE) 1	2	3	4	5	5. REMARKS (IF REDUNDANT ELEMENTS INDICATE WHICH ARE REDUNDANT & NO. NEEDED IN EACH MODE)
	RADAR	003	2		X				
SUB-SYSTEM / SET 1	Tracker #1	056	23	X	X				NO. 1 - SCAN MODE NO. 2 - TRACK MODE
2	Tracker #2	056	24	X	X				
3									
4									
5									
SUB-SYSTEM #1 EQUIPMENT / ASSEMBLIES 1	Antenna & Pedestal	02	1	X	X				
2	Transmitter	089	54		X				1 of 2 transmitters required in each mode
3	Transmitter	089	55		X				
4	Receiver	05	6	X	X				
5	Radar Scope	04	2	X	X				
6									
7									
8									
9									
SUB-SYSTEM #2 EQUIPMENT / ASSEMBLIES 1	Antenna & Pedestal	02	2	X	X				
2	Transmitter	089	56		X				1 of 2 transmitters required in each mode
3	Transmitter	089	57		X				
4	Receiver	05	7	X	X				
5	Radar Scope	04	3	X	X				
6									
7									
8									
9									

7 April 1966

Failure Reporting and Data Feedback Systems Established in Shipyards & Laboratories

A survey was conducted in order to establish whether there is an existing failure reporting system established in shipyards and laboratories that would provide sufficient data to perform a reliability and maintainability engineering analysis. All shipyards were visited except Pearl Harbor. The following laboratories were visited: Applied Science Laboratory, Boiler and Turbine Laboratory, Electronics Laboratory, and Underwater Sound Laboratory. Other activities visited were Fleet Missile Systems Analysis and Evaluation Group and Naval Ship Missile System Engineering Status. Upon completion of the survey, an analysis was performed and the conclusion was that there is no existing data feedback system that could be expanded to provide the required data without degrading the original system or completely rerouting the data flow. The four data collection and feedback systems encountered during the survey are discussed in the following sections.

I. Data System:

Fleet Ballistic Missile Weapon System

Trouble and Failure Reporting System

A. Purpose of Data System:

1. Pinpoint specific problem areas for decisions by management.
2. Assess equipment failure rates and establish failure trends.
3. Assess the adequacy of maintenance and repair parts levels through use information.
4. Provide operational data with which to improve the reliability of the weapon system.
5. Provide a means for the fleet to report on adequacy of repair and maintenance procedures.

B. Where Data System used:

1. Factory acceptance tests.
2. Shipyard installation tests.
3. SDAP tests.
4. Assembly operations.
5. Tactical use.

C. Data Inputs:

1. Standard Forms:

a. Fleet Ballistic Missile Weapon System, Trouble and Failure Report (TFR), SP Form 3100.1A.

b. Fleet Ballistic Missile Weapon System TFR/Corrective Action Report, SP Form 3100.1C (Rev 2-64).

c. Fleet Ballistic Missile Weapon System elapsed time meter record SSB(N)627 Class Navigation Department. SP Form 3100.1B7 (2-65).

2. Data Elements:

a. Preparing Activity.

b. Date of failure.

c. Original TFR No. of Item received.

d. Subsystems, Model, Modification, Serial No.

e. Equipment, Serial No.

f. Component, Serial No.

g. Other identification, Serial No.

h. Mfg. Part/DWG No. of the lowest level identified in d, e, f, or g. Indicate whether repaired, adjusted, or replaced by new item.

i. FSN and Serial No. of new item.

j. Repair time.

k. Was reference material adequate.

l. Trouble or failure description.

(1) Indication of trouble/failure.

(2) Action taken & dispositions of failed item.

(3) Description of trouble/failure

(4) Recommendations.

(5) Probable cause.

3. Data Sources:

a. All SP contractors furnishing tactical hardware.

b. All SSBN and tender construction facilities.

c. Test facilities.

d. Ships Force, SSB(N) and tenders.

e. FBM assembly and repair facilities.

f. FBM training facilities.

D. How Data Processed:

1. The TFR form is a four part carbon backed form. The original is sent to FMSAEG, the blue copy is attached to the failed part, the green copy is sent to the assigned Squadron Weapons Officer and the yellow copy is retained by the originator. The original form is received by FMSAEG, reproduced and distributed to cognizant FMSAEG engineers where they are analyzed, coded, computer processed, and stored. A copy reproduced by FMSAEG is also sent to interested activities as specified by Special Projects Office. If corrective action in the form of modification is deemed necessary it can be instituted by contractor, FMSAEG engineers, or any interested activity but must be approved by Special Projects. Summary reports are periodically sent to interested activities in order to complete the feedback system and to demonstrate that the TFR's are important and are being processed.

E. Data Outputs:

1. Data Formats:

The following information is sent to contractors, SSB(N) and tenders, Navy Activities, and Special Projects Office:

a. Bi-monthly Fleet Trouble and Failure Report.

b. Semi-yearly shore Trouble & Failure Report.

c. TFR Listing.

d. Special Reports.

2. Data Uses:

The outputs listed above are analyzed and provide basis of

of decisions and evaluations by:

a. Management on Equipment and Subsystems:

(1) Performance

(2) Availability

(3) Readiness

(4) Reliability assessment

(5) Maintainability

(6) Serviceability

b. Operations:

(1) Schooling in TFR preparation by fleet personnel.

(2) Optimize maintenance techniques.

(3) Maintenance time per subsystems.

(4) Maintenance skill level determination.

(5) Maintenance staffing requirements.

(6) Improve procedures, instructions, publications.

c. Engineering:

(1) Modification requirements (SPALTS).

(2) Modification (SPALTS) effectiveness.

(3) Improvement in subsystems and equipments components.

(4) Quality, reliability, serviceability improvement in maintenance.

d. ESO:

(1) Spares requirements.

(2) Part unavailability.

F. Advantages:

An excellent system that provides all data necessary to perform engineering analysis, evaluate performance, and continuously control and monitor the program.

G. Disadvantages:

None. This data feedback system accomplishes the purpose for which it was intended.

H. Recommendations for Implementation in Shipyards:

Although TFR and analysis system is an excellent feedback system and accomplishes the purposes for which it was intended, it could not be implemented throughout the shipyards without major alterations. The major area of non-compatibility would be in the area of data flow, In order for a shipyard reporting system to be effective the failure must be analyzed locally and the corrective action implemented as soon as possible.

II. Data System:

Electronic Data Processing System

A. Purpose of Data System:

The broad objective of this collection, analysis and feedback system is to improve electronic equipment reliability and maintainability through the analysis of maintenance and operational data from the fleet.

B. Where Data System Used:

The electronic data processing system is being replaced by the Standard Navy Maintenance and Material Management (3M) System. At the present time the 3M system is not fully operational and the electronic data processing forms (787 Form, proposed) are still being filled out by a number of ships in the fleet. Combat Systems Division and the Electronics Shop in the shipyards are also filling out 787 forms in certain instances. The AN/SQS-26 Savor Project Office is using 787 forms to collect failure data for the analysis that is being performed by NSAL. Other fleet and shore equipment failures are being analused at the David W. Taylor Model Basin.

C. Data Inputs:

1. Standard Form, DD-787 (Proposed)
2. Data Elements:
    a. Designation of ship or station.
    b. Repaired or reported by
        (1) U.S. Navy
        (2) Contractor
        (3) Civil Service

c. Type of Report

(1) Operational failure

(2) PM (POMSEE)

(3) PM (not POMSEE)

(4) Stock Defective

(5) Repair of replaceable unit

(6) Others

d. Time failure occured or maint. began.

e. Time failure cleared or maint. completed.

f. Model type Designation.

g. Equipment Serial No.

h. Contractor (Navy code or complete name).

i. First indication of trouble.

j. Operational conditions.

k. Time meter readings.

l. Repair time (man hours).

m. Lowest designated unit (u) or subassembly (SA).

n. Lowest designated U/SA Serial No.

o. Reference designation.

p. Federal Stock Number.

q. Mfg. of removed item.

r. Type of failure.

s. Primary or secondary failure.

t. Cause of failure.

u. Disposition of removed item.

v. Replacement available locally.

w. Repair time factors.

x. Remarks.

3. Data Sources

a. Fleet

b. Shipyards

c. Contractors

D. How Data Processed:

Failure reports, operational time logs, performance and operational reports, informal and other reports from the fleet shipyards, and other shore activities are sent to the David W. Taylor Model Basin where the information is coded edited, punched on cards and processed by use of a computer. The processed data is analyzed and the following reports and information are sent to BUSHIPS.

1. Monthly Analytical Reports.
2. Part failure rates.
3. Modification reports.
4. Failure Effects Analysis.
5. Maintenance evaluation.
6. Special reports.

The information received by management, Electronics Supply Office, operation, and engineering from the data processing center is further analyzed and formulated into corrective actions and improvements to be implemented in the equipment in the fleet.

The completed DD-787 failure reports being filled out on the AN/SQS-26 Sonar failed components, are sent to the Naval Applied Science Laboratory. There the information from the failure reports is coded edited and processed by use of a control Data Corp. Model 3200 computers. Printouts are sent to interested activities monthly. The failed components and the associated circuitary are analyzed and, if waraanted, recommendations are submitted to the AN/SQS-26

Program Office for the modification of the circuitary or the changing components.

E. Data Outputs:

1. Data Formats

a. Computer Printouts

b. Special Reports

c. Failure rates

2. Data Uses:

a. Management uses the data to measure:

(1) Equipment performance

(2) Equipment availability

(3) Mean-time-to-failure

(4) Mean-time-to repair

(5) Maintenance ratio

(6) Maintenance delay factors and a basis to initiate interrogations.

b. Electronic Supply Office uses the data to establish:

(1) Spares requirements.

(2) Part unavailability.

c. Operations uses the data to:

(1) Optimize maintenance techniques.

(2) Establish maintenance time per equipment.

(3) Establish PM schedules.

(4) Establish PM procedure.

(5) Establish maintenance skill levels and staffing requirements.

d. Engineering uses the data to establish:

(1) Modification requirements.

(2) Modification effectiveness.

(3) Maintenance routines improvement.

(4) Equipment and components improvement.

F. Advantages:

The electronic data processing system provides sufficient data to enable an engineering analysis and a basis for establishing improvements and corrective action.

G. Disadvantages:

None, it accomplishes the task for which it was intended.

H. Recommendation for Implementation in shipyards:

Although the electronic data process system provides the data necessary to perform an engineering analysis, it is not being recommended for use in the shipyards for the following reasons:

1. This system has been established as a BUSHIPS electronics failure reporting system and would require excessive monitoring to collect data on electrical and mechanical parts since the system is associated strictly with electronics equipment.
2. All procedures and directives would have to be rewritten.

III. System:

Submarine Antenna Failure/Deficiency Reporting System

A. Purpose of Data System:

To improve quality workmanship, procedures and operational availability of submarine antenna systems.

B. Where Data Systems Used:

1. Fleet

2. Shipyards and repair facilities

C. Data Inputs:

1. Standard Form: Submarine Antenna System Failure/Deficiency Report (NAVSHIPS 4895 (Rev 11-63)

2. Data Elements:

a. Ship

b. Antenna/system

c. Date

d. Description of defective part or component

e. Antenna position at time of casualty

f. Operating conditions at time of casualty

g. Degree to which system performance affected

h. First indication of trouble

i. Photographs or parts available for inspection

j. Narrative remarks

k. Equipment History

(a) Defective part installed by

(b) Previous trouble

l. Cause of trouble

m. Comments:

n. Recommended corrective action

3. Data Sources

a. Fleet

b. Shipyards and repair facilities

D. How Data Processed:

The completed 4895 form is distributed to the following activities, NAVSHIPYD Phila. (Code 1600) Original, BUSHIPS (Code 671), USNUSL, Submarine Force Commander, Squadron Commander, Commanding Officer. Once the original 4895 form is received by code 1600, at the Phila. Shipyard, the report is screened for accuracy and completeness and logged in by ship, and by one of the following six (6) failure classifications.

(1) Installation and/or Insufficient Inspection

(2) Inadequate or Improper Design

(3) Failure due to unknown cause

(4) Failure due to operational error, or improper maintenance procedures

(5) Worn Out

(6) Accident

Charts are kept updated by listing each failure received. A quarterly summary report is written and sent to each participating activity. A listing of weekly failures is routed through Engineering and Quality Assurance activities within SAQAF. Corrective action is recommended by the SAQAF to the BUREAU. At the present time all failure data is processed manually, but it is planned to begin punching the failure data on EAM cards. Printouts will be separated on the following columns, hull no., antenna type,

classification of error, installing activity, failed component, how component failed, and who reported the failure (Ship, shipyard, private shipyard, etc.) A monthly bulletin is circulated which updates procedures, gives maintenance hints, list problems and corrective actions encountered by activities during the preceeding month.

E. Data Outputs:

1. Data Formats:

a. List of failures that occured during preceeding week

b. Monthly bulletin

c. Quarterly summary reports

2. Data Uses:

The data is used to pinpoint problem areas, a basis for corrective action, a mean to communicate and exchange ideas, and to improve the operational availability of the antenna systems.

F. Data System Advantages:

Provides some data for engineering analysis; and a means for evaluating the effectiveness of the antenna improvement programs. Collects failure on mechanical, electrical, and electronic parts.

G. Data System Disadvantages:

No operating time is recorded and not enough data is collected to perform a reliability and maintainability engineering analysis.

H. Recommendation for Implementation in Shipyards:

It is not recommended that this reporting system be implemented throughout the shipyard since the system was designed and is limited to the collection of failure data on submarine antenna systems.

IV. System:

Defect Prevention Reporting Program

A. Purpose of Data System

The purpose of this system is to eliminate the receipt of defective material and equipment.

B. Where Data System Used:

1. Naval Shipyards
2. Repair facilities
3. Supervisor of Shipbuilding

C. Data Inputs

1. Standard form: There is no standard form. Each activity prepares it's own.
2. Data Elements:
   a. Reporting activity
   b. DPR No.
   c. Manufacturer's name and address
   d. Contract no. under which material was procured
   e. Equipment, noun description
   f. Stock/part no.
   g. Serial, heat, lot, batch, melt number, etc.
   h. Identification of such facts as specifications, paragraph, drawing, demensions, etc. to which the product is not in conformance.
   i. Description of non-conformity
   j. Cause of defect
   k. Quantity of defective equipment
   l. Number of previous DPR's generated against the manufacturer

m. Cost of equipment

n. Cost of repair

o. Defect classification

p. Material disposition

q. Other

r. Action Required

D. How Data Processed

The Defect Prevention Reports are originated by the Naval Shipyards, Repair Facilities and Supervisors of Shipbuilding. A copy of all DPR's are sent to BUSHIPS, Code 609.1, where they are forwarded to AEFF, Code 1813. AEFF has the responsibility of monitoring the defect preventions reporting program. When DPR's are received by AEFF and problem areas are identified, corrective action is initiated. If the discrepancy is due to inadequate specifications or was written against government furnished equipment, a copy of the DPR goes to the BUSHIPS TECH Codes where the problem is investigated and corrective action initiated. If the DPR was a result of Material not conforming to specification requirements or if due to Quality Control of the vendor, a copy of the DPR is sent to cognizant INSMAT and corrective action is initiated. A copy of the corrective action is sent BUSHIPS Code 609.1 and to the originator of the original DPR.

E. Data Outputs:

1. Data Formats

There is no standard output format; each DPR is handled individually.

2. Data Uses:

The reporting system is a Quality Control tool used to improve the material received and to evaluate vendors.

F. Data System Advantages:

The information collected in this reporting system could be used as supplemental data for an engineering failure reporting system.

G. Data System Disadvantages:

The data collected on DPR are not sufficient to perform an R&M engineering analysis.

H. Recommendation for implementation in shipyards

Not recommended since it does not fullfill the need of reliability and maintainability engineering.

APPENDIX E

REFERENCE MATERIAL USED DURING THE STUDY

APPENDIX E

REFERENCE MATERIAL USED DURING THE STUDY

Background Material

1. NAVMATNOTC 3900, MAT325/KNS, 16 February 1966
   Subject: SecNAV Policy for Reliability of Naval Material

2. Tech Log. Inst. 4355.2, Ser. 602/609-88, 17 August 1965
   Subject: MIL-STD-785 Military Standard "Requirements for Reliability Program (and/or Systems and Equipment)", implementation of.

3. BuShips Instruction 9400.10C, Ser. 641-199, 30 April 1965.
   Subject: Machinery other than Navy Nuclear Propulsion Plant Machinery; Engineering and Technical Assistance for.

4. BuShips, Ser 935-M2, 31 January 1966
   Subject: Management Information for the Maintenance Data Collection System (MDCS): forwarding of

5. BuShips, Ser. 604-438, 26 July 1965
   Subject: Maintenance Data Collection System (MDCS) Data Element Changes and Modifications; request for.

6. BuWeps RREN-2:RBB, 9 December 1964
   Subject: Standard Navy Maintenance Management System; comments concerning

7. BuShips, 4700, Ser. 604-184, 23 March 1965
   Subject: Standard Navy Maintenance and Material Management (3M); Maintenance Data Collection System (MDCS) management products and summaries

8. GWU-LRP Report Serial T170 15 April 1964
   Subject: Survey of Information Requirements for Navy Maintenance and Material Management.

9. GWU-LRP Tech Memo TM-12066 13 Novemeber 1964
   Subject: Description and Scheduling of Management Products for the Navy MMM Program.

10. Navweps OD 29304, 15 May 1965
    Subject: Guide Manual for Reliability Measurement Program

11. SMS-231 Presentation at BuShips 10 March 1966
    Subject: 3-M Application Concepts.

12. Auerbach Corporation, 1254-TR-1, 10 May 1965
    Subject: NADC Data Product Requirements from MMM Data Base.

13. MIL HDBK-217A - Reliability Stress and Failure Rate Data for Electronic Equipment

14. MIL-STD-756A - Military Standard Reliability Prediction, 15 May 1963

Data Collection Systems (Surface)

1. Report No. FSO-1-R-001, APL, Silver Spring, Maryland
   Subject: The SAM Fleet Reporting System. An Integrated Program of Reliability, Operability, and Failure Data Processing and Analysis For Surface Missile Systems.

2. Utilization of SMS Operability and Failure Data Conference of 6 August 1964. (APL)

3. Report No. FSO-1-R-034, 12 November 1964, APL
   Subject: Utilization of the Maintenance Data Collection System in Support of the Surface Missile Systems Project.

4. BuWeps 13070.1B, FQ, 19 December 1963
   Subject: Bureau of Naval Weapons Aeronautical Malfunction Reporting Program
   Forms: NAVWEPS Form 13070/1 (3-61)
   NAVWEPS Form 13070/2 (3-61)
   NAVWEPS Form 13070/3 (10-62)

5. BuShips 10550.73 Ser. 695C-707, 28 June 1961
   10550.73A Ser. 679C1-714, 7 October 1964
   10550.73A, Ch. #1 Ser. 679C1-1012, 17 December 1964
   Subject: Revised Electronic Failure Reporting System, implementation of (BuShips Report Symbols 10550-1 and 10550-14).

6. Training Guide, Navy Service Failure Analysis Program, Completion of Electronic Equipment Failure/Replacement Report DD-787(Proposed), Report BuShips 10550-1 and Electronic Equipment Operational Time Log Nav Ships 4855. Prepared by ITT, (FEC) for Fleet Technical Branch, BuShips.

7. Phase 1, II, Vol. 1, Vol. 2 Reports, Navy Service Failure Analysis Program, Prepared by ITT(FEC) under contract NObsr 81385, for Fleet Technical Branch, BuShips.

8. BuShips 9670.20D, Ser. 694D-14, 13 April 1961.
   Subject: Electronics Performance and Operational Reports, BuShips 9670-1 (NAV Ships 3878), With changes 1 through 3.

9. Report BuShips 9120-1, Sample Form, Report of Equipment Failure NAV Ships 3621 (Rev. 6-59)

10. Preliminary, Planned Maintenance System for the ASW - Dash Weapon System, prepared by ComCruDesLant, PMS Office (Code 418C), Newport, R.I.

11. ComCruDesLantInst 4701.5 - Sup.,
    Subject: Maintenance Data Collection Pocket Manual

12. OPNAV 43P2, March 1965
    Subject: Maintenance and Material Management (3-M) Manual with change 1.

13. Army Equipment Record Procedures, January 1964 Technical Manual 38-750

Data Collection Systems (Naval Air)

1. BuAer NAVAER00.58B, AER-MA-61, 1 March 1957 with change 4 dated 30 November 1959.
   Subject: Naval Aeronautical Material Reliability Program Sample Forms
   Sample Forms: - NAVACR 3069
   DO 787

2. BuWeps Inst. 4700.2, 21 June 1962
   Subject: The Naval Aircraft Maintenance Program

3. OP-43C/CJ, Ser. 839P43, 4 June 1965
   Subject: Naval Aviation Maintenance and Material Management Manual. with changes 1, 2, 3, Incorporated. (1 Aug. 1965)

4. WR-30 1 May 1963 (MEARS)
   Subject: Integrated Maintenance Management for Aeronautical Weapons, Weapons Systems and Related Equipment

Data Systems, USAF

1. AFM-66-1
   Subject: Maintenance Management

2. USAF Sys Comd Form 258-5, Data Collection System.

3. USAF ADC Regulation 66-28, 12 February 1964
   Subject: Interceptor Sortie Evaluation.

4. USAF SAC Form 126-
   Subject: Air Vehicle Mission Record.

5. USAF AFTO Form 29
   Subject: Unsatisfactory Report

6. USAF AFTO Form 109
   Subject: Quality Control Deficiency Report

7. AFSC-TR65-3 January 65
   Subject: "Data Collection and Management Reports." WSEIAC Task Group III Final Report.

8. AFSC-TR65-6 January 1965
   Subject: WSEIAC, Chairman's Final Report

9. USAF, Minutes of Meeting on Data Analysis Manual 14-18 September 1964.

10. USAF, Minutes of Systems Effectiveness Data Meeting, Headquarters Air Force Systems Command, 29-31 March 1965.

(11) Air Force Logistics Command.
Subject: (a) DO-56B Series Products
(b) DO-56C Series Products

Data System Products

1. OPNAVINST 4700.20, OP-43B3, Serial 1460P43, 11 November 1965
Subject: Standard Navy Maintenance and Material Management System (3-M System) Data Products; procedure for major product users to submit specific requirements for

2. MSO, Mechanicsburg, Pennsylvania
Subject: Maintenance Support Office, Catalogue of 3-M Products.

3. CNAL 533B, Serial 6378, 22 December 1965.
Subject: 3-M Aviation Data Product Requirements from MSO; submission of

4. MSO, Mechanicsburg, Pennsylvania Date: 10 December 1965.
Subject: Maintenance Data Collection System, Validation Specifications for Shipboard Reporting.

5. MSO, Mechanicsburg, Pennsylvania
Subject: Description of EIC Summary File

6. MSO, Mechanicsburg, Pennsylvania 10 December 1965
Subject: Maintenance Data Collection Systems, Validation Specifications for Naval Air Activities

7. NWS, Concord
Subject: Data Products from NAVWEPS Form 8000/13 Data Summaries.
   A. 1A Sequence - Event Data By: Serial Number of Equipment
   B. 1B Sequence - Part Data By: Part Reference Designator
   C. 1C Sequence - Event Data By: Component/Assembly
   D. 1D Sequence - Part Data By: Part Identity
   E. Remarks extracted from NAVWEPS 8000/13 reports

8. NWS, Concord
Subject: NAVWEPS Form 8000/23 Time Meter Reports

9. NAVSHIPS 3621, Failure Reporting System
   (a) Management Summary Report
   (b) Equipment Failures by Manufacturers
   (c) Commodity Report by CID
   (d) CID Failures Summary Report
   (e) Commodity Report, All nuclear by CID.
   (f) Commodity Report, All SSBN by CID.
   (g) Commodity Summary Report
   (h) Failure Summary Report by Ship.

(i) Ship component failures breakdown
(j) Component frequency distribution plot.
(k) Remarks, Summary Reports.

10. DTMB, derived from 10550-14
Subject: Standby and Radiate Status Tabulation

11. DTMB, derived from 10550-1
Subject: (a) Report 2A, Reliability/Maintainability Figure of Merit Summary
(b) Report 21, Equipment Performance Summary Report

12. NATSF, derived from NAVWEPS 13070/3
Subject: (a) TAB-40 FUR Detail Listing
(b) TAB-40 Maintainability Listing
(c) TAB-45 FUR Detail List Associated Parts Repaired or Replaced.

13. MSO, Mechanicsburg, Pennsylvania SN MMMS
Subject: Shipboard Comparative Analysis of Scheduled versus Unscheduled Maintenance Report, For DF10, D320, DES RON-22
(a) Table of Scheduled Maintenance Performance Ratios
(b) Table of Preventive Maintenance Performance Ratios
(c) Table of Planned Maintenance Performance Ratios
(d) Table of Total Man-Hours for Total Maintenance - Man-hours in Units.
(e) Table of Total Man-hours for Scheduled Maintenance - Man-Hours in Units.
(f) Table of Total Man-Hours for Planned Maintenance - Man Hours in Units
(g) Table of Total Man-Hours for Corrective Maintenance - After Preventive Maintenance - Man-Hours in Units.
(h) Table of Total Man-Hours for Preventive Maintenance - other than MRC - Man-Hours in Units.

14. SNMMMS Product MDC-5
Subject: Sample Maintenance History Record for DD Class Ship.

15. COMOPTEVFOR Instruction P3930-ID Volume II, 1 August 1964
Subject: Project Instructions

16. Patuxent Naval Air Station (MEARS)
Subject: Automatic Reliability and Maintenance Management System

Summary Data Systems

1. FARADA - Failure Rate Data Program FMSAEG, Corona, 1 April 1965
2. IDEP - Interservice Data Exchange Program FMSAEG, Corona.
3. Memorandum, MAT 3254, 21 December 1965
   Subject: Inventory of Technical Data Systems
4. NAVAPLSCIENLAB 3920.4, 6 January 1966
   Subject: Procedures for making requests of Navy Automated Research and Development Information System (NARDIS)
5. NASA PRINCE INDEX, October 1965
   "Parts Reliability Information Center"
6. NASA APIC INDEX, November 1965
   "Apollo Parts Information Center"
7. MONITOR DATA SYSTEM, March 1966
   The Institute for Cooperative Research, University of Pennsylvania

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   Subject: Reliability and Maintainability of Military Electronic Equipments
2. ARINC Research, Monograph No. 8, 1 October 1959
   Subject: A Model for Scheduling Maintenance Utilizing Measures of Equipment Performance
3. ARINC Research, Monograph No. 9, 15 July 1960
   Subject: Concepts Associated with System Effectiveness
4. ARINC Research, 1 September 1960
   Subject: Effects of Maintenance Procedures on the Reliability and Maintainability of an Airborne UHF Communication Equipment
5. ARINC Research, 20 July 1962
   Subject: Special Report on Accuracy of AFM 66-1 Reporting
6. ARINC Research, Special Technical Report No. 7, 22 November 1963
   Subject: A System for Data Documentation Control
7. ARINC Research, 31 December 1963
   Subject: Maintainability Prediction Theoretical Basis and Practical Approach (Revised)
8. ARINC Research, January 1964
   Subject: System Effectiveness Concepts and Analytical Techniques
9. Proceedings of the 8th Navy-Industry Conference on Material Reliability, 11-12 May 1965
   Subject: Reliability - Maintainability; Fixed-Price Management

10. NAVSHIPS 94324, 1962
Subject: Maintainability Design Criteria Handbook for Designers of Shipboard Electronic Equipment

11. NAVWEPS OD 29304, 15 May 1965
Subject: Guide Manual for Reliability Measurement Program

12. Society of Automotive Engineers Handbook, April 1964
Subject: Reliability Control in Aerospace Equipment Development

13. AFSCR-TR-65 Volume II WSEIAC, Final Report of Task Group V January 1965
Subject: Management Systems (Elements of Effectiveness Assurance Management)

14. NATSF Technical Note 1-66
Subject: Development of an Integrated Maintenance Management Information Retrieval System

15. RADC-TR-65-214, February 1966
Subject: Validation of Discard-at-Failure Maintenance Mathematical Model

16. RADC-TN61-141, 15 June 1961
Subject: Maintainability Measurement and Prediction Methods for Air Force Ground Electronic Equipment. Phase III Progress Report

17. RADC-TN60-221, 15 September 1960
Subject: Maintainability Measurement and Prediction Methods for Air Force Ground Electronic Equipment Phase II Progress Report

18. ASD Technical Report 61-361, August 1961
Subject: Methods for Computing Manpower Requirements for Weapon Systems Under Development

19. An ASTIA Report Bibliography, January 1962

20. RADC-TN-60-5, 6 January 1960
Subject: A Research Plan for Developing Methods of Maintainability Measurement and Prediction (Phase 1 Report)

21. ESD-TDR-64-616, December 1964
Subject: Handbook for Reliability and Maintainability Monitors Technical Documentary Report No. ESD-TDR-64-616

22. SECNAV Instruction 3900.36, 27 January 1966

23. NAVMAT Notice 3900, 16 February 1966

24. INSURV Instruction 4730.11A, 29 November 1965

25. Data Requirements with Formats -- Failure Reporting, Aerospace Technology Corporation

26. Borg-Warner Controls Report No. 10169, dated 15 October 1962
Subject: Technical Proposal for SUS-4020 Reliability

27. Honeywell, Inc. Reliability Procedures Document R-ED 25078, dated 13 January 1960

28. General Electric Procedure Number 18.2, 20 November 1964
Subject: Discrepancy Data System

29. Martin Marietta Quality Procedure MM-1024 issued 20 January 1964, revised 1 July 1965
Subject: MARS Form

APPENDIX F

RELIABILITY AND MAINTAINABILITY DATA-COLLECTION FORMS

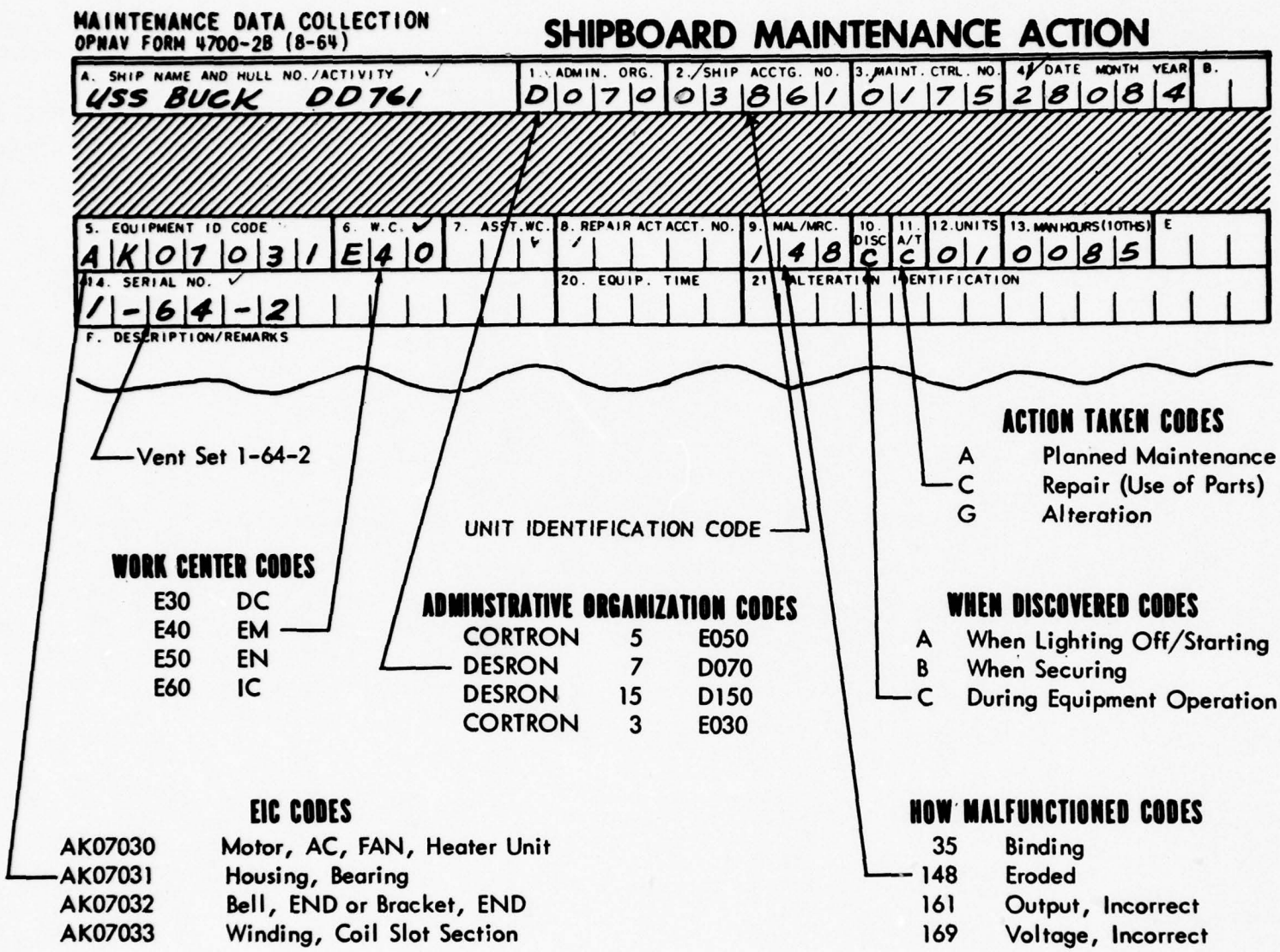


Figure 3-7. Samples of MDCS Codes and Representative Applications.

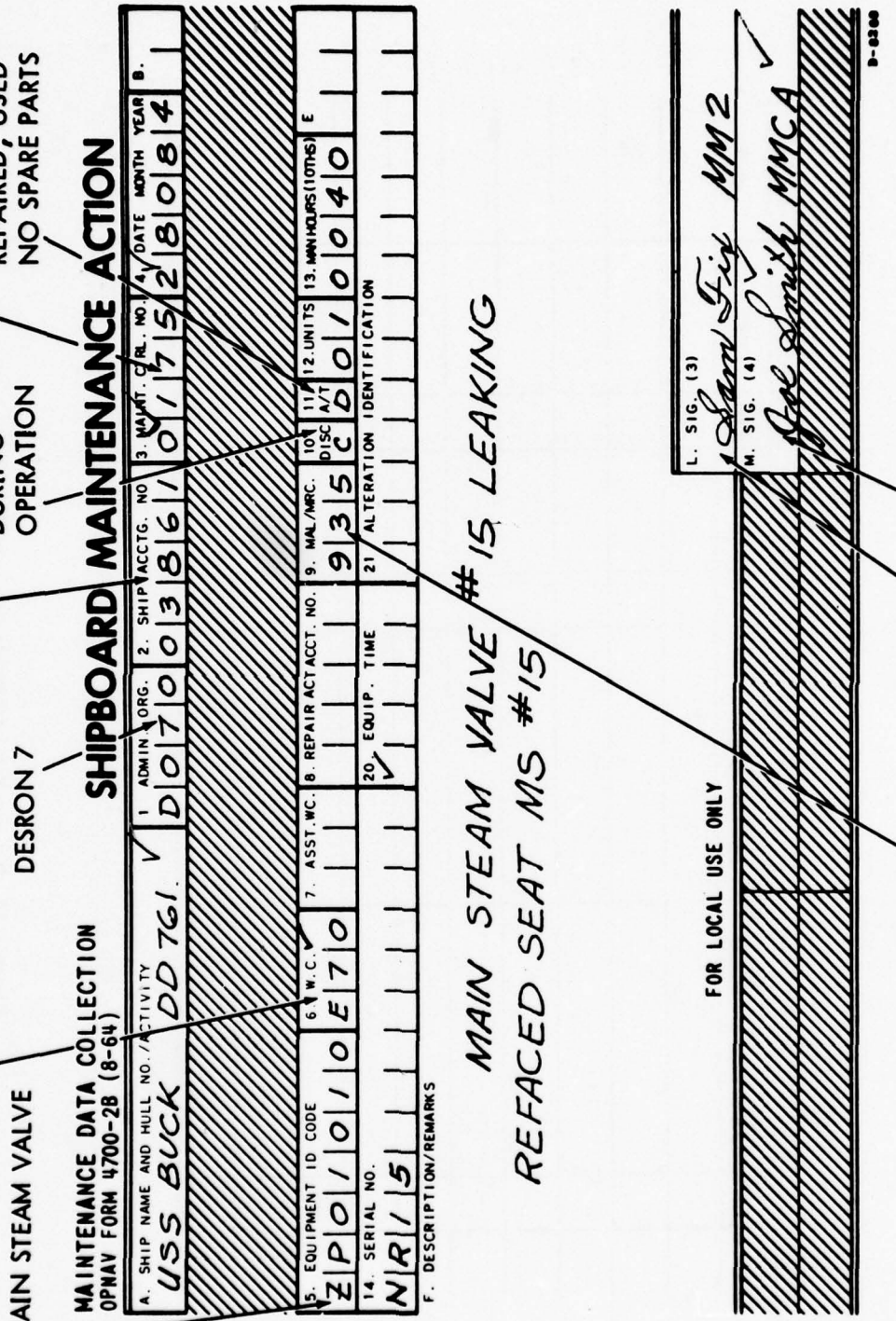


Figure 3-8. Shipboard Maintenance Action, OPNAV Form 4700-28.

CID/APL/AN
55376101

SOURCE CODE	COG.	FEDERAL STOCK NO./PART NO.	REFERENCE SYMBOL/NOVN	MATERIAL REQ. UNITS	MATERIAL REQ. QUANTITY	MATERIAL USED UNITS	MATERIAL USED QUANTITY	UNIT PRICE
1	IN	5905-258-0034	R1445			EA	2	.38

Figure 3-11. Reverse Side of OPNAV Form 4700-2 Series.

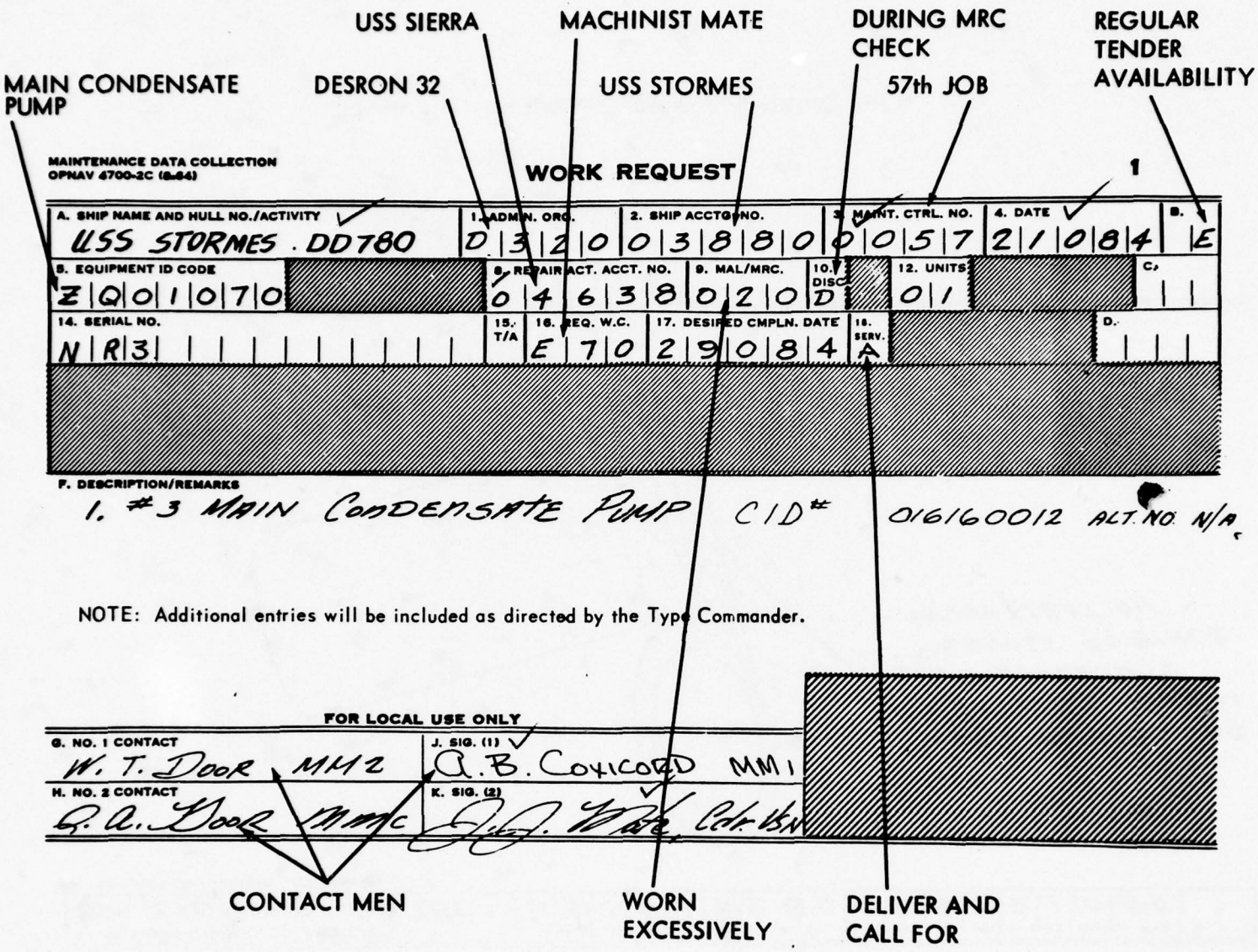


Figure 3-15. Work Request, OPNAV Form 4700-2C, Sheet 1.

MAINTENANCE DATA COLLECTION
OPNAV FORM 4700-2C (9-84) PART II

WORK REQUEST

A. SHIP NAME AND HULL NO./ACTIVITY	1. ADMIN. ORG.	2. SHIP ACCTG. NO.	3. MAINT. CTRL. NO.	4. DATE MONTH YEAR	5.
USS STORMES DD 780	D320	03880	00057	21 08 84	

F. DESCRIPTION/REMARKS (CONTINUED)

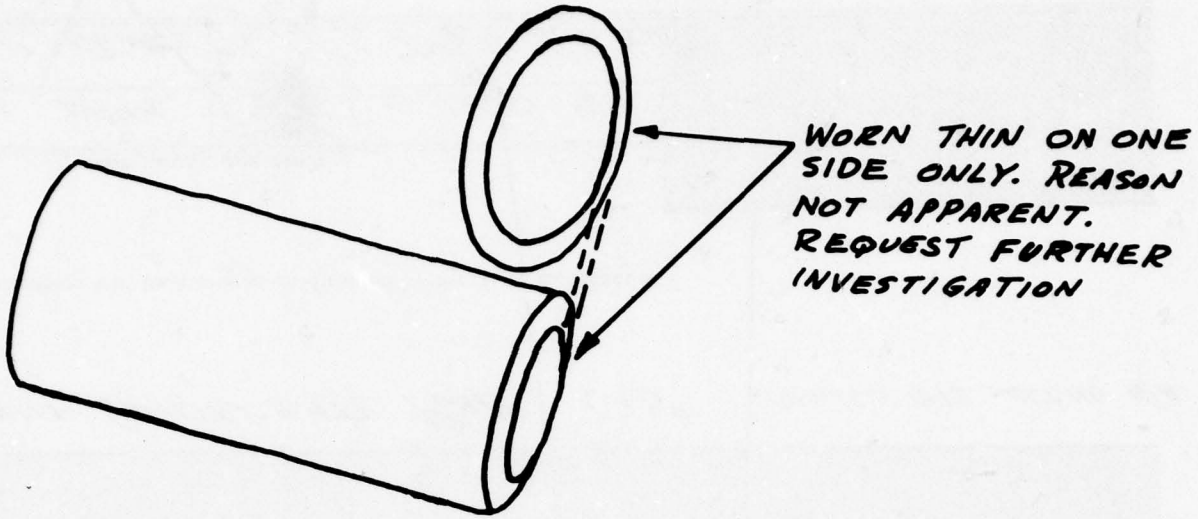


Figure 3–16. Work Request, OPNAV Form 4700–2C, Part II.

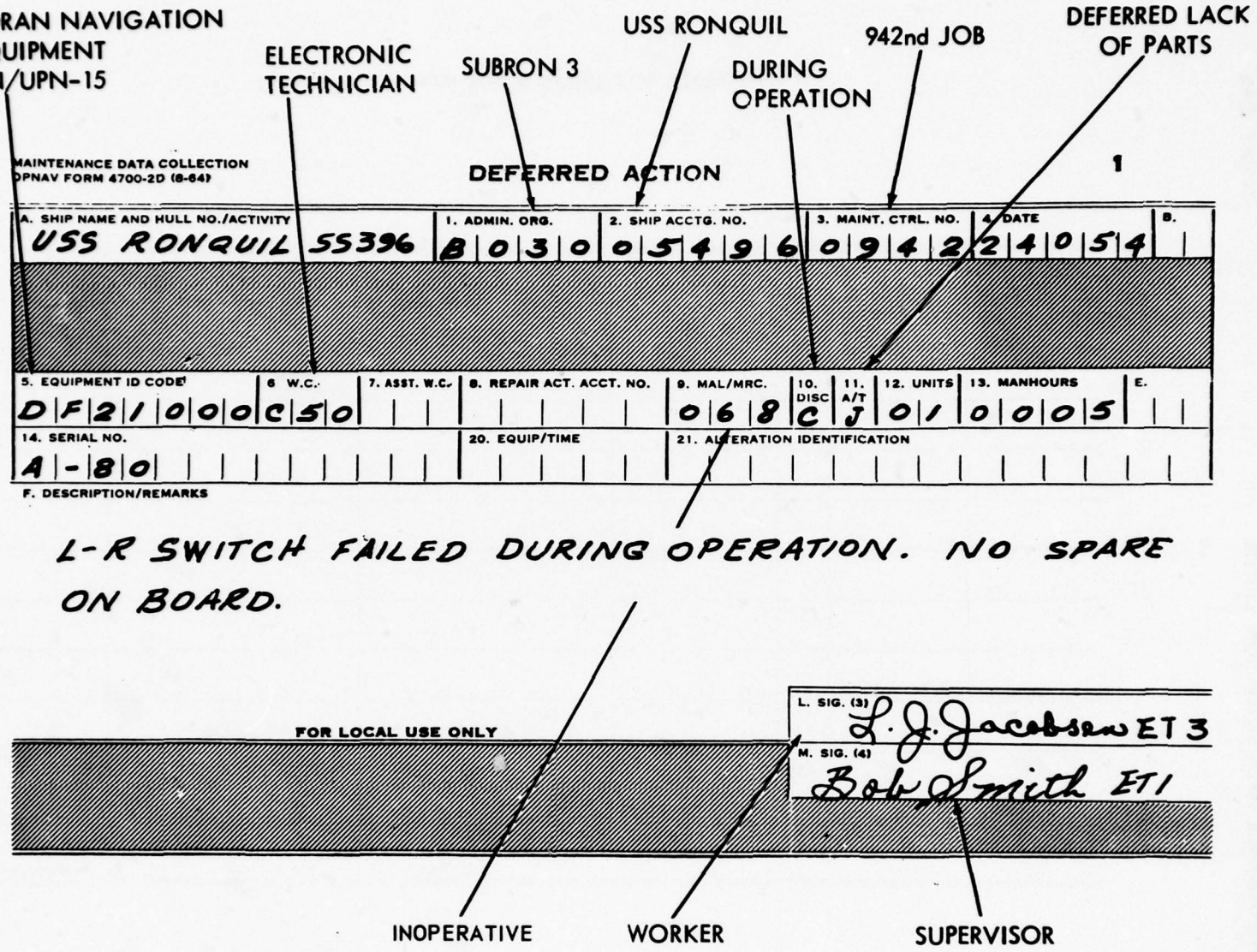


Figure 3-9. Deferred Action, OPNAV Form 4700-2D, Sheet 1.

CID/APL/AN

55376101

SOURCE CODE	COG.	FEDERAL STOCK NO./PART NO.	REFERENCE SYMBOL/NOVN	MATERIAL REQ. UNITS	MATERIAL REQ. QUANTITY	MATERIAL USED UNITS	MATERIAL USED QUANTITY	UNIT PRICE
1	IN	5905-258-0034	R1445			EA	2	.38

Figure 3-11. Reverse Side of OPNAV Form 4700-2 Series.

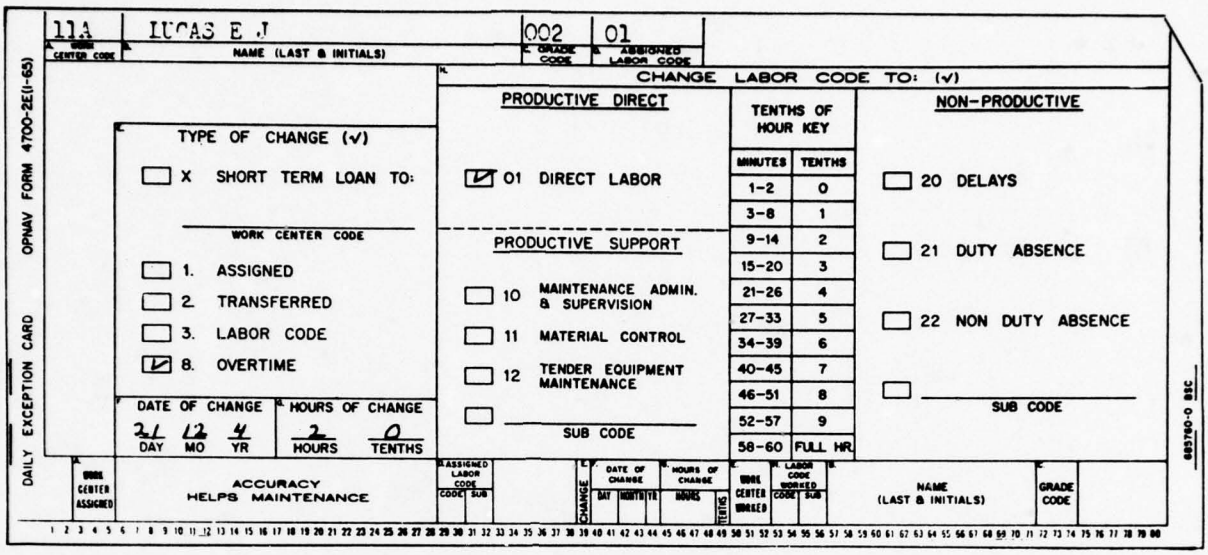


Figure 5-3. Overtime Work—In Assigned Work Center

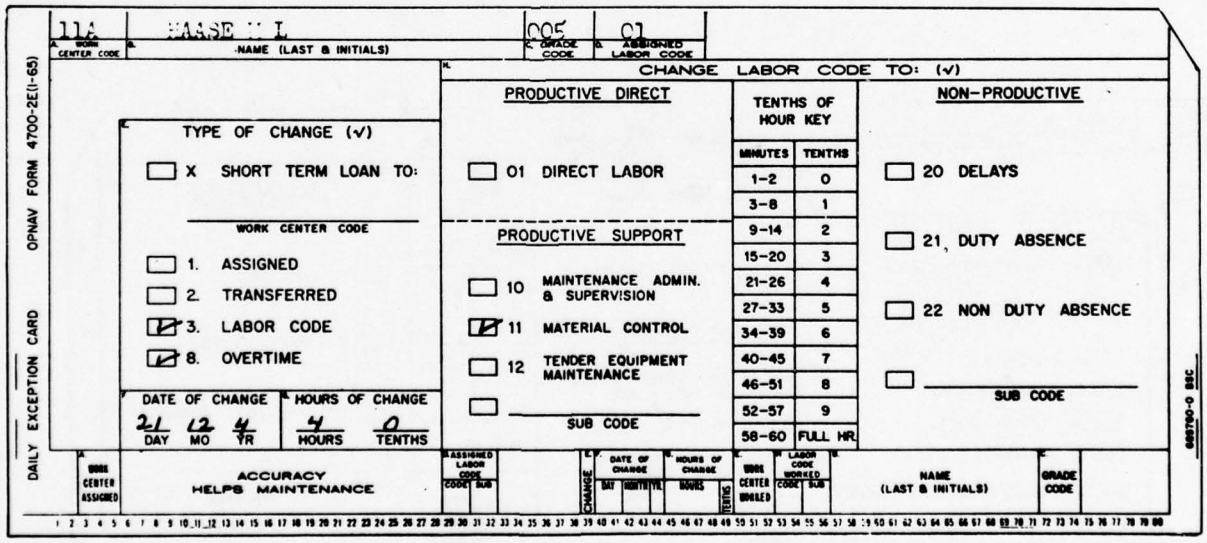


Figure 5-4. Overtime Work—Plus Labor Code Change.

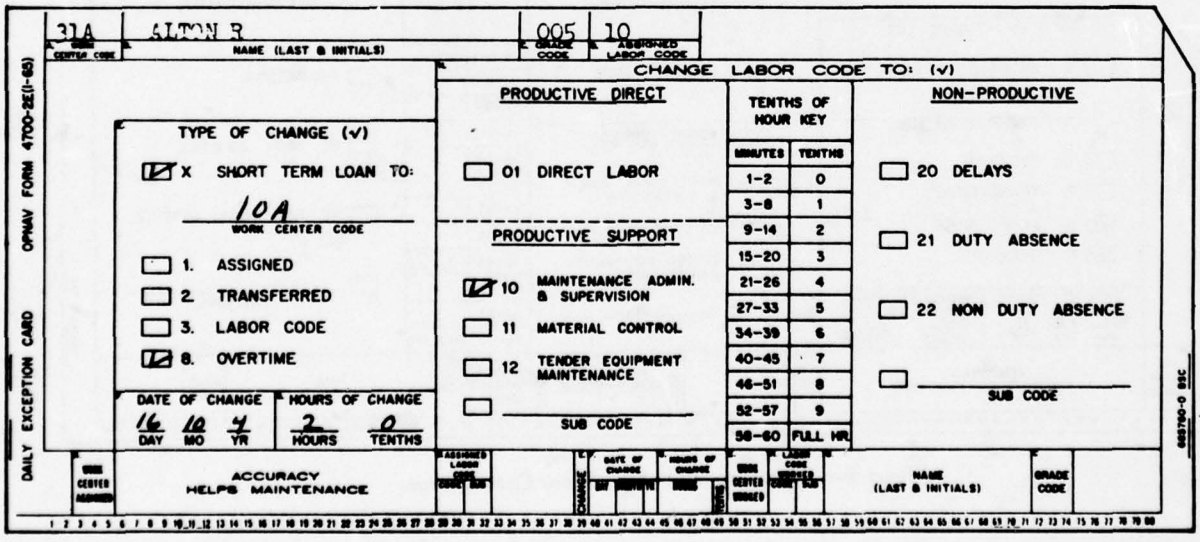
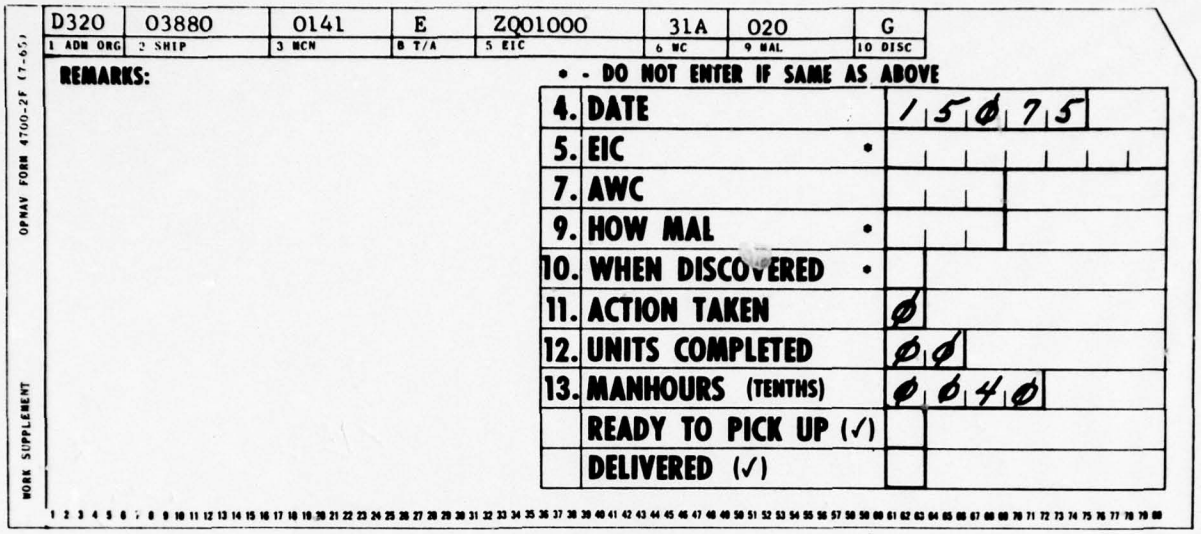


Figure 5-5. Overtime Work—Outside of Assigned Work Center, Same Labor Code.



1 ADM ORG	2 SHIP	3 MCN	8 T/A	5 EIC	6 WC	9 MAL	10 DISC
D320	03880	0141	E	Z001000	31A	020	G

OPNAV FORM 4700-2F (7-65)

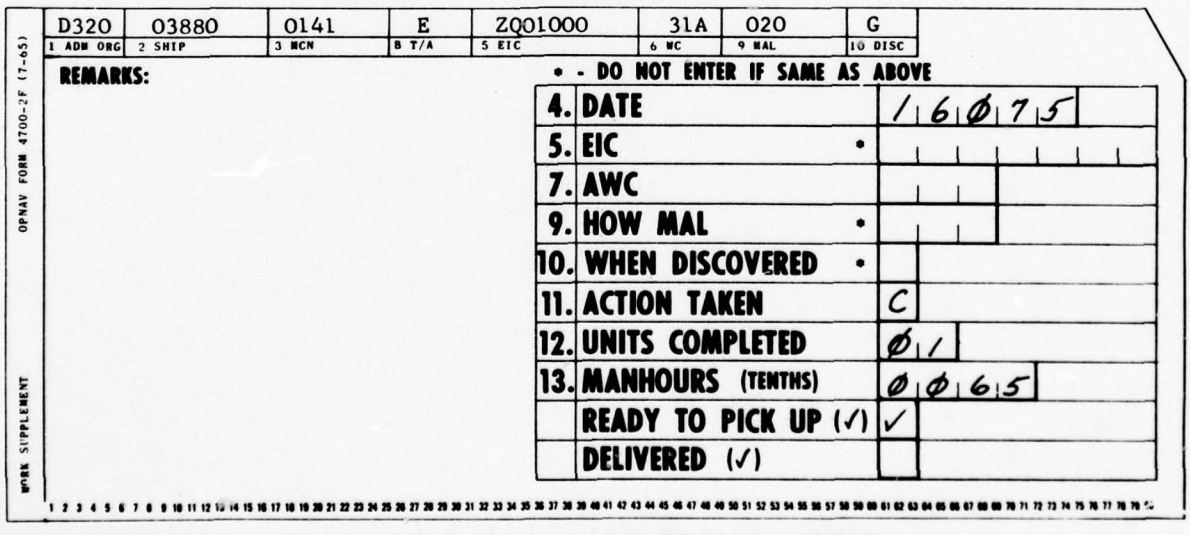
WORK SUPPLEMENT

REMARKS:

• - DO NOT ENTER IF SAME AS ABOVE

4.	DATE	15075
5.	EIC •	
7.	AWC	
9.	HOW MAL •	
10.	WHEN DISCOVERED •	
11.	ACTION TAKEN	Ø
12.	UNITS COMPLETED	ØØ
13.	MANHOURS (TENTHS)	Ø040
	READY TO PICK UP (✓)	
	DELIVERED (✓)	

Figure 4-2, Work Supplement Card, OPNAV Form 4700-2F. Daily Progress Report showing that Work Center 31A expended four (4) manhours on the maintenance action, but did not complete the repair.



1 ADM ORG	2 SHIP	3 MCN	8 T/A	5 EIC	6 WC	9 MAL	10 DISC
D320	03880	0141	E	Z001000	31A	020	G

OPNAV FORM 4700-2F (7-65)

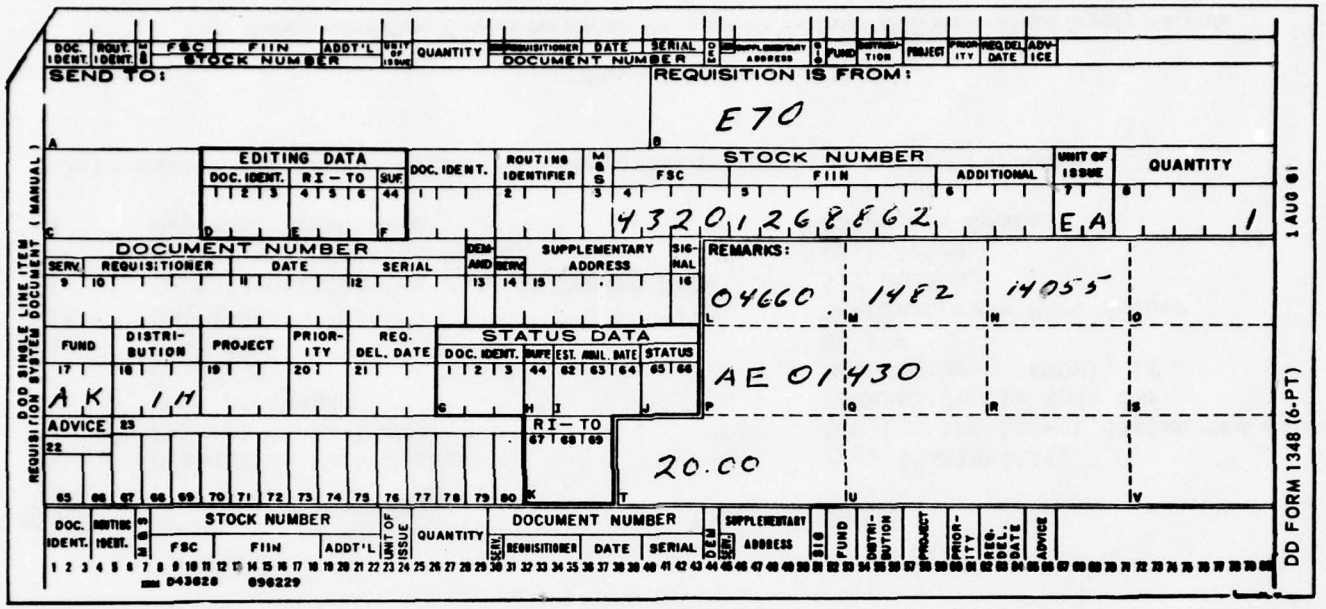
WORK SUPPLEMENT

REMARKS:

• - DO NOT ENTER IF SAME AS ABOVE

4.	DATE	16075
5.	EIC •	
7.	AWC	
9.	HOW MAL •	
10.	WHEN DISCOVERED •	
11.	ACTION TAKEN	C
12.	UNITS COMPLETED	Ø1
13.	MANHOURS (TENTHS)	ØØ65
	READY TO PICK UP (✓)	✓
	DELIVERED (✓)	

Figure 4-3, Work Supplement Card, OPNAV Form 4700-2F. Showing that Work Center 31A expended an additional 6.5 manhours on the maintenance action and that the item is now repaired and ready for pick-up.

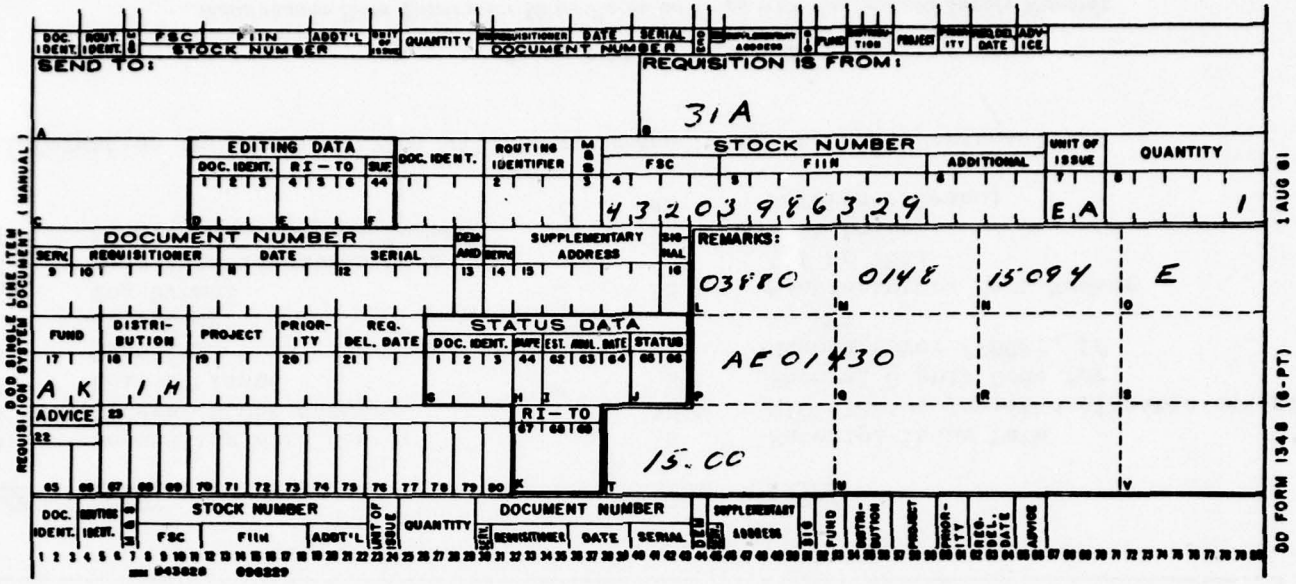


BLOCK	ENTRY	BLOCK	ENTRY
*B	Requesting Work Center	N	Material Issue Date
*4,5&6	Federal Stock Number	*P&Q	EIC (To the lowest designated assembly)
7	Unit of Issue	R	Federal Supply Code for Manufacturer (FSCM), if No FSN
*8	Quantity	*S	Manufacturers Part Number (If No FSN)
17	Fund Code	T	Unit Price
18	Cog Symbol	*U	Reference Symbol
L	Unit Identification Code		
*M	Maintenance Control Number		

* Information for these entries will be provided by Maintenance Personnel

Figure 3-13, DD Form 1348,

Maintenance Data Entries for Ships Force on Ships with Mechanized Supply Records



BLOCK	ENTRY	BLOCK	ENTRY
*B	Requesting Work Center	O	Type Availability
*4,5&6	Federal Stock Number	*P&Q	EIC (To the lowest designated assembly)
7	Unit of Issue	R	Federal Supply Code for Manufacturer (FSCM), if No FSN
*8	Quantity		
17	Fund Code		
18	Cog Symbol	*S	Manufacturers Part Number (If No FSN)
L	Unit Identification Code of Tended Ship		
*M	Maintenance Control Number	T	Unit Price
N	Material Issue Date	*U	Reference Symbol

* Information for these entries will be provided by Maintenance Personnel

Figure 3-14, DD Form 1348,.

Maintenance Data Entries for Repair Departments on Ships with Mechanized Supply Records

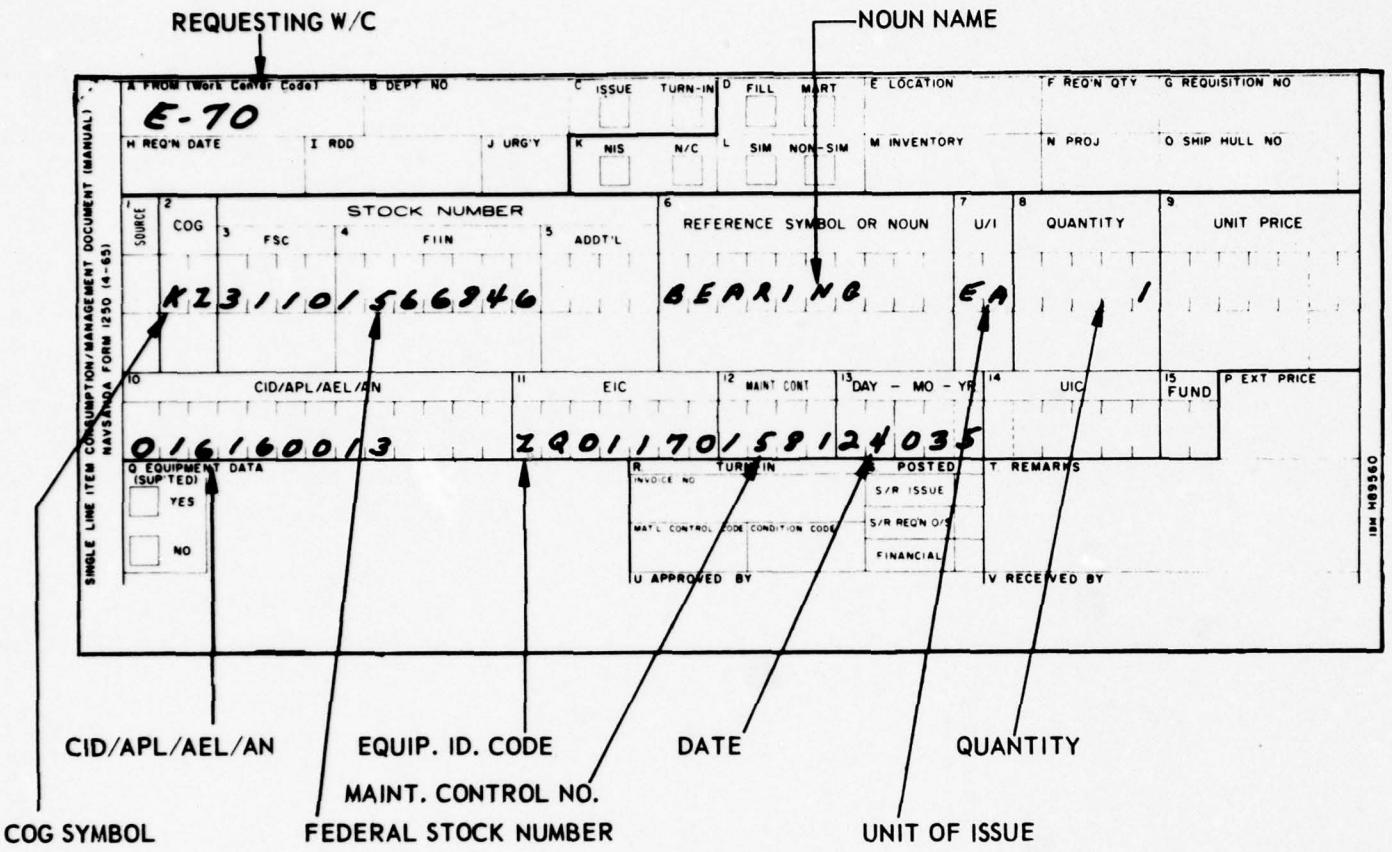
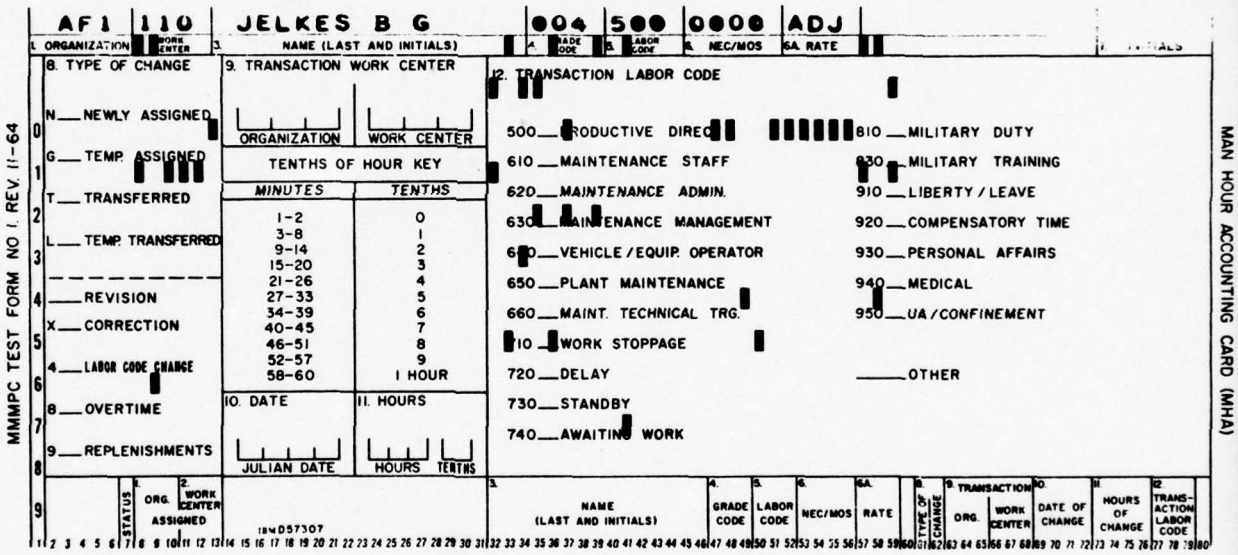


Figure 3-12, NAVSANDA 1250 Maintenance Data Entries for Ships with Non-Mechanized Supply Records.



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MAINTENANCE ACTION FORM
MMMPC TEST FORM #4 (Rev. 11 64)

1. JOB CONTROL NUMBER ORG.	DATE	SER	SUF	2. TYPE EQUIP	3. BU/SER NO.	4. ACTION ORG.	5. WORK CENTER	6. MAINT LEVEL	7. ACTION DATE
AC4	4198	535		AACD	150020	AC4	120	☑ ORG ☐ 2 INT ☐ 3 DEP	4198

8. WORK UNIT CODE	9. WHEN DISCD	10. TYPE MAINT	11. ACTION TAKEN	12. MAL	13. ITEMS PROC	14. MAN HRS	15. EMT	16.
030	0	S	0	000	1	8 0	2 0	

20. REMOVED ITEM .1 RIC/MFGR	.2 SERIAL NUMBER	A INSTALLED ITEM RIC MFGR	SERIAL NO
.3 PART NUMBER	.4 METER READING	PART NUMBER	

B. DISCREPANCY

1. CHECK AIRCRAFT FOR HARD LANDING

C. CORRECTIVE ACTION

INSPECTED FOUND CYLINDER ASSEMBLY, GEAR ACTUATING LEAKING

D. ENTRIES REQUIRED		SIGNATURE	E. CORRECTED BY	F. INSPECTED BY	G. SUPERVISOR
CONFIGURATION	☐ YES ☑ NO				
LOG	☑ YES ☐ NO	D Doak A2C	J White AMN2	Sgt Lt AMN1	Spoon AMHC
ACCESS RECORD	☐ YES ☑ NO				

30. REPAIR CYCLE DATA

	DATE		DATE
1. REMOVED		5. TO AWP	
2. RECEIVED MATL. CONTROL		6. OFF AWP	
3. WORK STARTED		7. TO AWP	
4. COMPLETED		8. OFF AWP	
RFI ☐ B COND ☐ R/S ☐		9.	
		0.	

H. PCN | PRIORITY | DATE DUE IN | OUT

40. FAILED MATERIAL

.1 ACT TRN	.2 MAL	.3 QTY	.4 MFGR	.5 PART NUMBER

J. ACCUMULATED HOURS

NAME/SHIFT	DATE	MAN HRS.	EMT
TOTAL			

K. REQUIRED MATERIAL

REQ. NO.	MFGR	PART NUMBER	QTY	PRI	DATE/TIME ORD	DATE/TIME REC	AWP

SINGLE COPY MAF (TEST FORM #4)

EXAMPLE OF CONDITIONAL INSPECTION FOR HARD LANDING.

Exhibit 3-1

MAINTENANCE ACTION FORM

MMMPC TEST FORM #5 (Rev. 11/64)

1. JOB CONTROL NUMBER (ORG. / DATE / SER / SUF)	2. TYPE EQUIP	3. BU/SER NO.	4. ACTION ORG.	5. WORK CENTER	6. MAINT LEVEL	7. ACTION DATE
AC4 / 4198 / 526 /	ABCD	150020	AC4	120	☒ ORG ☐ INT ☐ DEP	4198

8. WORK UNIT CODE	9. WHEN DISCD	10. TYPE MAINT	11. ACTION TAKEN	12. MAL	13. ITEMS PROC	14. MAN HRS	15. EMT	16.
13231	Q	B	R	381	1	6.0	2.0	

20. REMOVED ITEM .1 RIC/MFGR	.2 SERIAL NUMBER	A. INSTALLED ITEM RIC/MFGR	SERIAL NO.
ABDFM	24561	ABDFM	21572

.3 PART NUMBER	.4 METER READING	PART NUMBER	

B. DISCREPANCY

CYLINDER ASSEMBLY, GEAR ACTUATING LEAKING

C. CORRECTIVE ACTION

REMOVED AND REPLACED CYLINDER ASSEMBLY, GEAR ACTUATING - DROP CHECKED OK

D. ENTRIES REQUIRED — SIGNATURE

CONFIGURATION ☐ YES ☒ NO
LOG ☐ YES ☒ NO
ACCESS RECORD ☐ YES ☒ NO

E. CORRECTED BY	F. INSPECTED BY	G. SUPERVISOR
[signature] AMH	[signature] AMH	[signature] AMHC

30. REPAIR CYCLE DATA

	DATE		DATE
1. REMOVED	4198	5. TO AWP	
2. RECEIVED MATL. CONTROL		6. OFF AWP	
3. WORK STARTED		7. TO AWP	
4. COMPLETED		8. OFF AWP	
RFI ☐ B COND ☐ R/S ☐		9.	
		0.	

H. PCN | PRIORITY | DATE DUE IN | OUT

40. FAILED MATERIAL

.1 ACT TKN	.2 MAL	.3 QTY	.4 MFGR	.5 PART NUMBER

J. ACCUMULATED HOURS

NAME/SHIFT	DATE	MAN HRS.	EMT

K. REQUIRED MATERIAL

REQ. NO.	MFGR	PART NUMBER	QTY	PRI	DATE/TIME ORD	DATE/TIME REC	AWP
4121	18365	3547506-506	1	1	1500 4198	1330 4198	

COPY ONE MAF (TEST FORM #5)

DISCREPANCY DISCOVERED DURING INSPECTION OF AIRCRAFT FOR HARD LANDING. REPARABLE ASSEMBLY REQUIRED.

TOTAL

ORGANIZATIONAL MAINTENANCE CONTROL REGISTER

MP'MPC TEST FORM #6 (REV 11 64)

A. STATUS ↑ ↓	B. JCN.		H. LOCATION	K. DISCREPANCY	L. CORRECTIVE ACTION	M. AWP	Q. DATE TIME
C. PRI 1 2 3	D. BUNO SIDE NO.		I. WORK CENTERS 1 2 3			N. IN WORK	R. COMP
E. DISC.	F. EQUIP.	G. MAINT.	J. TIME REPORTED			P. PENDING	S. T FLT
A. STATUS ↑ ↓	B. JCN		H. LOCATION	K. DISCREPANCY	L. CORRECTIVE ACTION	M. AWP	Q. DATE TIME
C. PRI 1 2 3	D. BUNO/SIDE NO.		I. WORK CENTERS 1 2 3			N. IN WORK	R. COMP.
E. DISC.	F. EQUIP.	G. MAINT.	J. TIME REPORTED			P. PENDING	S. T FLT.
A. STATUS ↑ ↓	B. JCN.		H. LOCATION	K. DISCREPANCY	L. CORRECTIVE ACTION	M. AWP	Q. DATE TIME
C. PRI 1 2 3	D. BUNO/SIDE NO.		I. WORK CENTERS 1 2 3			N. IN WORK	R. COMP
E. DISC.	F. EQUIP.	G. MAINT.	J. TIME REPORTED			P. PENDING	S. T FLT.
A. STATUS ↑ ↓	B. JCN.		H. LOCATION	K. DISCREPANCY	L. CORRECTIVE ACTION	M. AWP	Q. DATE TIME
C. PRI 1 2 3	D. BUNO/SIDE NO.		I. WORK CENTERS 1 2 3			N. IN WORK	R. COMP
E. DISC.	F. EQUIP.	G. MAINT.	J. TIME REPORTED			P. PENDING	S. T FLT
A. STATUS ↑ ↓	B. JCN.		H. LOCATION	K. DISCREPANCY	L. CORRECTIVE ACTION	M. AWP	Q. DATE TIME
C. PRI 1 2 3	D. BUNO/SIDE NO.		I. WORK CENTERS 1 2 3			N. IN WORK	R. COMP
E. DISC.	F. EQUIP.	G. MAINT.	J. TIME REPORTED			P PENDING	S T FLT

Exhibit 7-5

ORGANIZATIONAL WORK CENTER REGISTER

MMMPC TEST FORM #7 (REV 11 64)

A. STATUS	B. JCN	H. LOCATION	K. DISCREPANCY	L. CORRECTIVE ACTION	M. AWP	Q. START
C. PRI 1 2 3	D. BUNO SIDE NO.	J. MEN ASSIGNED			N. IN WRK	R. STOP
E. DISC	F. EQUIP / G. MAINT				P. PEND	S. COMPL

A. STATUS	B. JCN	H. LOCATION	K. DISCREPANCY	L. CORRECTIVE ACTION	M. AWP	Q. START
C. PRI 1 2 3	D. BUNO SIDE NO.	J. MEN ASSIGNED			N. IN WRK	R. STOP
E. DISC	F. EQUIP / G. MAINT				P. PEND	S. COMPL

A. STATUS	B. JCN	H. LOCATION	K. DISCREPANCY	L. CORRECTIVE ACTION	M. AWP	Q. START
C. PRI 1 2 3	D. BUNO SIDE NO	J. MEN ASSIGNED			N. IN WRK	R. STOP
E. DISC	F. EQUIP / G. MAINT				P. PEND	S. COMPL

A. STATUS	B. JCN	H. LOCATION	K. DISCREPANCY	L. CORRECTIVE ACTION	M. AWP	Q. START
C. PRI 1 2 3	D. BUNO SIDE NO.	J. MEN ASSIGNED			N. IN WRK	R. STOP
E. DISC	F. EQUIP / G. MAINT				P. PEND	S. COMPL

A. STATUS	B. JCN	H. LOCATION	K. DISCREPANCY	L. CORRECTIVE ACTION	M. AWP	Q. START
C. PRI 1 2 3	D. BUNO SIDE NO	J. MEN ASSIGNED			N. IN WRK	R. STOP
E. DISC	F. EQUIP / G. MAINT				P. PEND	S. COMPL

Exhibit 7-6

INTERMEDIATE MAINTENANCE REGISTER
MMMPC TEST FORM =9 (Rev. 11 64)

WORK CENTER ____________

A. PCN	C. DATE DUE	D. PRI	E. ITEM IDENTIFICATION	F. REMARKS	G. DATE AWP	RFI ☐
B. JCN	IN ______				DATE OFF AWP	B Cond ☐
	OUT ______				DATE COMP	R/S ☐
A. PCN	C. DATE DUE	D. PRI	E. ITEM IDENTIFICATION	F. REMARKS	G. DATE AWP	RFI ☐
B. JCN	IN ______				DATE OFF AWP	B Cond ☐
	OUT ______				DATE COMP	R/S ☐
A. PCN	C. DATE DUE	D. PRI	E. ITEM IDENTIFICATION	F. REMARKS	G. DATE AWP	RFI ☐
B. JCN	IN ______				DATE OFF AWP	B Cond ☐
	OUT ______				DATE COMP	R/S ☐
A. PCN	C. DATE DUE	D. PRI	E. ITEM IDENTIFICATION	F. REMARKS	G. DATE AWP	RFI ☐
B. JCN	IN ______				DATE OFF AWP	B Cond ☐
	OUT ______				DATE COMP	R/S ☐
A. PCN	C. DATE DUE	D. PRI	E. ITEM IDENTIFICATION	F. REMARKS	G. DATE AWP	RFI ☐
B. JCN	IN ______				DATE OFF AWP	B Cond ☐
	OUT ______				DATE COMP	R/S ☐
A. PCN	C. DATE DUE	D. PRI	E. ITEM IDENTIFICATION	F. REMARKS	G. DATE AWP	RFI ☐
B. JCN	IN ______				DATE OFF AWP	B Cond ☐
	OUT ______				DATE COMP	R/S ☐
A. PCN	C. DATE DUE	D. PRI	E. ITEM IDENTIFICATION	F. REMARKS	G. DATE AWP	RFI ☐
B. JCN	IN ______				DATE OFF AWP	B Cond ☐
	OUT ______				DATE COMP	R/S ☐
A. PCN	C. DATE DUE	D. PRI	E. ITEM IDENTIFICATION	F. REMARKS	G. DATE AWP	RFI ☐
B. JCN	IN ______				DATE OFF AWP	B Cond ☐
	OUT ______				DATE COMP	R/S ☐
A. PCN	C. DATE DUE	D. PRI	E. ITEM IDENTIFICATION	F. REMARKS	G. DATE AWP	RFI ☐
B. JCN	IN ______				DATE OFF AWP	B Cond ☐
	OUT ______				DATE COMP	R/S ☐
A. PCN	C. DATE DUE	D. PRI	E. ITEM IDENTIFICATION	F. REMARKS	G. DATE AWP	RFI ☐
B. JCN	IN ______				DATE OFF AWP	B Cond ☐
	OUT ______				DATE COMP	R S ☐

PAGE NO. ____________

Exhibit 7-7

REPLENISHMENT

MMMPC TEST FORM NO. 10 REVISED NOVEMBER 1964

1 TYPE EQUIP.	2 ACT. ORG.	3 WORK CENTER	4 MAINT. LEVEL *	5 ACTION DATE	6 SUPPORT CODE	7 TYPE MAINT.	8 ITEMS PROC.	9 MAN HOURS	A LOCAL CONTROL	B SIGNATURE
AACD	AC4	310	1		010	A				

* MAINT. LEVEL 1 - ORG. 2 - INT. 3 - DEP.

10 REPL ☑

D Brown SUPERVISOR

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

SUPPORT ACTION FORM

This type of SAF will be submitted when pre-punched/pre-printed cards are authorized and replenishment is desired. No other transactions may be entered on this type SAF.

Exhibit 3-37

SUPPORT ACTION FORM

MMMPC TEST FORM NO. 10 REVISED NOVEMBER 1964

1 TYPE EQUIP.	2 ACT. ORG.	3 WORK CENTER	4 MAINT. LEVEL *	5 ACTION DATE	6 SUPPORT CODE	7 TYPE MAINT.	8 ITEMS PROC.	9 MAN HOURS	A LOCAL CONTROL	B SIGNATURE
AFTL	AC4	310	1	4261	010	A	26	1600		J Bolton
AFTL	AC4	310	1	4261	030	A	10	800		

* MAINT. LEVEL 1 - ORG. 2 - INT. 3 - DEP.

10 REPL ☐

J Bolton SUPERVISOR

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

SUPPORT ACTION FORM

This type of SAF may be submitted by the work center supervisor to document total support manhours for his men for one day on a single SAF.

Exhibit 3-38

MMMPC TEST FORM NO. 10 REVISED NOVEMBER 1964

1 TYPE EQUIP.	2 ACT. ORG.	3 WORK CENTER	4 MAINT. LEVEL *	5 ACTION DATE	6 SUPPORT CODE	7 TYPE MAINT.	8 ITEMS PROC.	9 MAN HOURS	A LOCAL CONTROL	B SIGNATURE
AACD	AC4	310	1	4275	020	A	6	.75		[signature]

* MAINT. LEVEL 1 - ORG. 2 - INT. 3 - DEP.

10 REPL

[signature] SUPERVISOR

SUPPORT ACTION FORM

This type of SAF may be submitted by an individual worker to account for his time only.

Exhibit 3-39

SUPPORT ACTION FORM

MMMPC TEST FORM NO. 10 REVISED NOVEMBER 1964

1 TYPE EQUIP.	2 ACT. ORG.	3 WORK CENTER	4 MAINT. LEVEL *	5 ACTION DATE	6 SUPPORT CODE	7 TYPE MAINT.	8 ITEMS PROC.	9 MAN HOURS	A LOCAL CONTROL	B SIGNATURE
AACD	AC4	310	1	4275	030	E	.1	.13		[signature]
AFTL	AC4	310	1	4275	020	A	.2	.21		
AACD	AC4	310	1	4275	030	C	.1	.15		
AACD	AC4	310	1	4275	010	A	7	.111		
AFTL	AC4	310	1	4275	020	A	5	.30		

* MAINT. LEVEL 1 - ORG. 2 - INT. 3 - DEP.

10 REPL

[signature] SUPERVISOR

SUPPORT ACTION FORM

This type of SAF may be submitted to account for multiple actions

Exhibit 3-40

TECHNICAL DIRECTIVE COMPLIANCE FORM

MMMPC TEST FORM #11 (REV 11/64)

STATISTICAL DATA

1. JOB CONTROL NUMBER	2. TYPE EQUIP	3. BU/SER NO.	4. ACTION ORG.	5. WORK CENTER	6. MAINT. LEVEL 1 2 3 ☐ ORG ☐ INT ☐ DEP	7. ACTION DATE

8. SYSTEM	9. STATUS	10. MAN HRS	11. EMT	12. INTERIM ☐ YES ☐ NO	13. TECHNICAL DIRECTIVE IDENTIFICATION .1 CODE	.2 BASIC NO.	.3 REV.	.4 AMD	.5 PART	.6 KIT	14. CORR.

46. OLD ITEM .1 RIC/MFGR	.2 SERIAL NUMBER	47. NEW ITEM .1 RIC/MFGR	.2 SERIAL NUMBER
.3 PART NUMBER		.3 PART NUMBER	

MAINT. CONTROL

A. PRI	B. PRIMARY WORK CENTER	C. ASST. WORK CENTERS	D. BY DATE	E. EST M/H	F. CREW SIZE	G. KIT REQD. ☐ YES ☐ NO	H. SE REQD ☐ YES ☐ NO

I. REMARKS

MATERIAL

A. MATERIAL/KIT STOCK NUMBER	B. DATE ORDERED	C. STUB NO.	D. DATE RECEIVED	F. ISSUED BY

E. REMARKS — G. DELIVERED BY

H. DATE

WORK CENTER

A. STATUS ↑ ↓	C. REMARKS	G. STATUS CODES
B. SAMI/CAMI NO.		A–ASSISTING WORK CENTER
		C–COMPLIED WITH
		D–DOES NOT APPLY
		P–PREVIOUSLY COMPLIED WITH
		W–WORK IN PROGRESS

D. ACCOMPLISHED BY	E. INSPECTED BY	F. SUPERVISOR

LOGS & RECORDS

A. COMPLIANCE RECORDED ON HISTORICAL RECORDS ☐ LOG ☐ ACCESSORY CARD — B. DATE SIGNATURE

C. CONFIGURATION FORM ☐ YES ☐ NO — DATE — SIGNATURE — D.

TECHNICAL DIRECTIVE COMPLIANCE FORM

CONFIGURATION CONTROL FORM
MMMPC TEST FORM #12 (Rev. 11/64)

1. ACTION ORG.	2. TYPE EQUIP.	3. BU/SER NO.	4. ACTION DATE	A. TECHNICAL DIRECTIVE IDENTIFICATION CODE	BASIC NO.	REV.	AMD	PART	KIT

B. NOMENCLATURE	5. REASON CODE	6. TIME CYC/Meter	7. ACT TKN	8. RIC/MFGR CODE	9. SERIAL NO.	10. PART NUMBER
			P ☐ Q ☐			
			P ☐ Q ☐			
			P ☐ Q ☐			
			P ☐ Q ☐			
			P ☐ Q ☐			
			P ☐ Q ☐			
			P ☐ Q ☐			
			P ☐ Q ☐			
			P ☐ Q ☐			

C. ENTRIES REQUIRED

LOG ☐ YES ☐ NO

DATE

SIGNATURE

D. REASON CODES

A - TDC Part Number Change
B - Failure
C - Time Change
D - No defect

CONFIGURATION CONTROL FORM

MATERIEL MAINTENANCE RECORD

NOTE: EXCEPT WHERE DATES ARE SPECIFIED, ALL TIMES WILL BE RECORDED IN HOURS AND TENTHS

ALL TIMES RECORDED ARE_____

1. UNIT TYPE DESIGNATION	2. UNIT SERIAL	4. TIME FAILURE OCCURRED				7. TYPE OF MAINT.
		MONTH	DAY	YEAR	TIME	☐ CORRECTIVE
3. TIME METER READINGS		5. TIME MAINTENANCE BEGAN				☐ PREVENTIVE
A. FILAMENT/ STANDBY	B. HIGH VOLTS/ RADIATE	MONTH	DAY	YEAR	TIME	☐ OTHER (EXPLAIN IN REMARKS)
C. AUXILIARY METER NO. 1	D. AUXILIARY METER NO. 2	6. TIME MAINTENANCE COMPLETED				8. TYPE OF FAILURE
E. AUXILIARY METER NO. 3	F. AUXILIARY METER NO. 4	MONTH	DAY	YEAR	TIME	☐ CRITICAL
						☐ MAJOR
						☐ MINOR

9. MANHOUR ACCOUNTING

A. PERSON(S) PERFORMING MAINTENANCE	B. RATE TITLE	C. SHIP, STATION, OR COMPANY	D. HOURS WORK

E. TOTAL MANHOURS EXPENDED EXCLUDING DELAYS

10. ACTUAL WORKING TIMES (DO NOT INCLUDE TWO CATEGORIES IN THE SAME TIME PERIOD)

A. PREPARATION (SETTING UP TOOLS, TEST EQUIPMENT, ETC.)	B. FAULT LOCATION (TROUBLESHOOTING)	C. REPAIR (REPLACEMENT OF DEFECTIVE PARTS)
D. CHECKOUT (TEST AND ALIGN AFTER REPAIR)	E. PREVENTIVE MAINTENANCE	F. OTHER (EXPLAIN IN REMARKS)

G. TOTAL ACTUAL WORKING TIME EXCLUDING DELAYS

11. DELAY TIMES IN REPAIR COMPLETION (DO NOT INCLUDE TWO CATEGORIES IN THE SAME TIME PERIOD)

A. PARTS PROCUREMENT (ON BOARD OR OFF)	B. WAITING OUTSIDE HELP (BEYOND SHIP'S FORCE CAPABILITY)	C. HIGHER PRIORITY EQUIPMENT MAINTENANCE
D. NOT PERMITTED TO WORK (EXPLAIN IN REMARKS)	E. WEATHER CONDITIONS (EXPLAIN IN REMARKS)	F. SHIP'S ROUTINE (MEALS, WATCHES, LIBERTY, ETC.)
G. TOOLS OR EQUIPMENT NOT AVAILABLE (EXPLAIN IN REMARKS)	H. SLEEP	I. EQUIPMENT IN USE

J. TOTAL DELAY TIME IN REPAIR COMPLETION

12. PART REPLACEMENT DATA (CHECK HERE ☐ IF CONTINUED ON ADDITIONAL SHEET)

A. COMPLETE CIRCUIT SYMBOL	B. PART DESCRIPTION	C. TYPE OF FAILURE CODE	D. CAUSE OF FAILURE CODE	E. PRIMARY OR SECONDARY FAILURE?	F. WAS REPLACEMENT AVAILABLE ON BOARD

13. REMARKS (CHECK HERE ☐ IF CONTINUED ON ADDITIONAL SHEET)

PAGE_____

Preceding Page Blank - Not Filmed

OPERATING TIME LOG

MONTH__________________

ALL TIMES RECORDED ARE______________

NOTES: A CHANGE IN EQUIPMENT POWER OR STATUS OF LESS THAN ONE TENTH HOUR (SIX MINUTES) NEED NOT BE RECORDED

1. DATE	2. TIME POWER OR STATUS CHANGED	EQUIPMENT POWER (CHECK ONE ONLY)			EQUIPMENT STATUS (CHECK ONE ONLY)			9. ELAPSED TIME (HOURS AND TENTHS)	10. REMARKS (REASON FOR CHANGE IN POWER OR STATUS IF OTHER THAN ROUTINE OPERATION)
		3. POWER OFF	4. STANDBY	5. OPERATE	6. FULLY OPERATIONAL	7. PARTIALLY OPERATIONAL	8. INOPERATIVE		

FARADA

BACKGROUND INFORMATION ON FAILURE RATE DATA - FARADA PROGRAM
NAVMAT FMSAEG 0800 V (10-64)

TO SUPPORT "TABULAR FAILURE RATE DATA SUMMARY"

ACTIVITY	REPORT NUMBER OR IDENTIFICATION	DATE OF REPORT
✓ XYZ Company ✓ ✓	ABC-123 ✓ ✓	2-21-65 ✓ ✓

I. DESCRIPTION OF EQUIPMENT(S) TESTED OR UNDER SURVEILLANCE

A. DESCRIPTION, SYSTEM TYPE, INTENDED FUNCTION

AN/FSQ-7 - large high speed digital computer for use in real-time ✓ air defence problems

B. PRODUCTION STATUS (Production, Prototype, breadboard)

Prototype ✓

C. AGE OF EQUIPMENT(S) PRIOR TO COMMENCEMENT OF TEST OR SURVEILLANCE	D. VINTAGE OF EQUIPMENT (Year of operational status)
2 years ✓	1962 ✓

II. CONDITION OF TEST (or surveillance)

A. DATE AND DURATION

✓ 1 October 1961 ✓ through ✓ 31 December 1963 ✓

B. ENVIRONMENT (ground, aircraft, laboratory, normal field operations, accelerated life, etc., complete word description including geographical location) ✓

✓ Equipment housed in special environmentally controlled building at a classified location.

C. MAINTENANCE (routine replace and repair, preventative, etc.)

✓ Some preventative maintenance in addition to routine replace and repair.

III. SYSTEM STATISTICS

A. TOTAL SYSTEMS (number of equipments)

✓ 1 Computer

B. TOTAL OPERATING TIME AND TIME BASE (flight hours, heater hours, equipment hours)

✓ 8500 hours of equipment operation

C. SYSTEM MEAN TIME, TOTAL NUMBER OF FAILURES

✓ 842 Catastrophic failures
Approximately 10 hours MTBF

SAMPLE

IV. FAILURE REPORTING SYSTEM

A. CONTROLLED OR UNCONTROLLED, METHOD OF REPORTING, PERSONNEL

✓ Controlled; laboratory failure reports and equipment removal tags under the immediate surveillance of professional personnel.

B. DEFINITION OF FAILURE

✓ Significant removal rate defined as the total removals minus accidental damage removals, removals due to failure of another component noted, and "no defect found" removals.

C. ESTIMATED PERCENT OF TOTAL FAILURES REPORTED

✓ 95 to 100%

Please refer to Pages 4.10 and 4.11 of the FARADA "Standard Operating Procedure" (SP 63-467) for sample presentation of "Background Information on Failure Rate Data".

V. PART FAILURE MODES (for each part type, list failure modes and number of parts failing in each mode)

PART IDENTIFICATION	FAILURE MODE	NO. OF FAILURES
Semiconductor, Diodes	Open	141
" "	Shorted	87
" "	Back Resistance Undersize Limit	22
" "	Unstable	5
" "	Total	255
Power Transistor, Silicon	Open	7

VI. PART FAILURE TIMES (list exact failure times for each failed part, where ...)

PART IDENTIFICATION	OPERATING TIME	NO. OF FAILURES
Capacitor, Ceramic	7255 hours	1
Semiconductor, Diode, Hermetic	825 hours	1
Power Transistor, Silicon	2000-2500 hours	3
" "	4500-6000 hours	2
Resistor, Carbon Comp.	7500-8500 hours	1

VII. SPECIAL ENVIRONMENTAL CONDITIONS (list all environments not given on "Tabular Failure Rate Data Summary")

Power surges to the AN/FSQ-7 occurred approximately 4 times per week because of the relative instability of the on-site power generators. These surges were as high as 130 percent of nominal.

VIII. ADDITIONAL INFORMATION (continue on additional sheets as required)

These data are a composite of two separate efforts of succeeding time periods (References a and b, respectively). The two groups of data were integrated into this single report since they describe the same equipment and the component failure rates were very similar.

IX. REFERENCES

(a) Cox, J.C., "A Preliminary Reliability Analysis of the AN/FSQ-7 Computer," Proceedings of the 12th National Symposium on Reliability and Quality Control, pp 372-380.

(b) Mann, J.J., "The AN/FSQ-7, A Reliability Progress Report," Proceedings of the 17th RETMA Symposium of Applied Reliability, pp 75-82.

TABULAR FAILURE RATE DATA SUMMARY – FARADA PROGRAM

NHD-FMSAEG-8803-10 (10-64)

"BACKGROUND INFORMATION ON FAILURE RATE DATA" Should also be provided.

ACTIVITY: XYZ Company | REPORT NUMBER: ABC-123 | DATE OF REPORT: 2-21-65

ENVIRONMENTAL STRESS CONDITIONS

(1) PART/COMPONENT COMPLETE NOMENCLATURE (Identification including MIL Spec. No. if applicable)	(2) OBSERVATION ENVIRONMENT	(3) INTENDED INSTALLATION (End Use) ENVIRONMENT	(4) PARTS X HOURS IN MILLIONS	(5) NUMBER OF FAILURES	(6) FAILURE RATE	(7) PART/COMPONENT POPULATION	(8) PERCENT OF RATED: VOLTAGE	CURRENT	POWER	FREQUENCY	PRESSURE	(9) TEMPERATURE: TYPICAL	UNION	LOW	SPECIFIED	(10) VIBRATION: MECHANICAL: SINUSOID	RANDOM	INTENSITY	ACOUSTIC: MAXIMUM INTENSITY	TYPICAL	TYPICAL DURATION	TYPICAL NUMBER OF BROAD-BAND EVENTS	(11) SHOCK: TYPICAL	RANGE	(12) PRESSURE: TYPICAL	RANGE	(13) RELATIVE HUMIDITY: TYPICAL	RANGE	(14) RADIATION: TOTAL ABSORBED IN BODY TISSUE	TYPE	(15) REFERENCE (Source Document)
							%	%	%	%	%	°C	°C	°C	°C	g	cps	g² cps	g				psia	psia		%	%		rads		
Capacitor, Fixed, Mica Molded Chassis Mount	Life Test Temp. Extreme	Aircraft	0.896	1	1.12	56	80				50													14.7	40							Report APR-321
Semiconductor, Transistor Germanium PNP, 2N274	Normal Full Operation	Laboratory	0.196	0		14			7.5		25													14.7	45							Report BTS-119-1
Gyroscope, Rate, Non-Sealed, Miniature, Ball Bearing	AGREE (Life) Test	Missile	0.05	3	60	19			50		30	70	-55	25	4									14.7	40							Report LD-20-117
Valve, Nitrogen, Regulator, Solenoid, 3000 psi	Qualification Test	Satellite	0.025 cycles	0		8				50														14.7	40							Report LD-25-591
Switches, Electrical, Toggle, Sensitive, DPST	Qualification Test	Missile	0.0075 Actuation		133 Actuation	7,503	30				10			500	8									14.7	40							Report TBS-63-1092

SAMPLE

NOTE: (a) The following coding is used for radiation type: NUCLEAR: A - Fast, B - Slow, C - Thermal | ELECTROMAGNETIC: D - Gamma, E - X-Ray | CHARGED PARTICLES: F - Proton, G - Electron, H - Mesons and ions

Please refer to Page 4.02 of the FARADA "Standard Operating Procedure" (SP 63-467) for sample presentation of "Tabular Failure Rate Data Summary"

JCN - ✓ S	MAINT. LEVEL ✓ 1 2	WUC	RATE ✓	NEC ✓	WIC ✓	DATE ✓	SERVICE # ✓

COLUMN	A	B	C	D	E	F	G	H	J	K	L	M	N	O
START TIME	SETUP	OPEN ACCESS	VERIFY MALFUNCTION	LOCALIZE TROUBLE	ISOLATE FAULT	REMOVE / DISASM	REPAIR / INTCHG	INSTALL / REASM	ADJ/ RIG/ CAL/ ALIGN	FUNCT-IONAL TEST	QUAL. CONTRL. INSP.	REMOVE SSE TOOLS	CLOSE ACCESS	CLEAR JOB
TIME COMPLETE														
	PREPARATION		FAULT LOCATION			FAULT CORRECTION				VERIFICATION		CLOSE-OUT		

LOG ALL WORK DELAYS

1. PARTS
2. TOOLS
3. MATERIALS
4. FACILITIES
5. SPECIAL EQ.
6. PERSONNEL
7. TECH. AIDS
0. OTHER

✓

COLUMN	P	R	S	T	U	W	X
STOP TIME							
REASN.							
RESUME TIME							
TASK COLUMN							

CIRCLE APPARENT MALFUNCTION CAUSE ✓

1 DESIGN	3 INSTALLATION	5 GR TECHNIQUE	7 SECOND FAIL.
2 MFG/OVERHAUL	4 MAINTENANCE	6 CONTAMINATION	0 UNDETERMINED

✓ ✓

COLUMN	REMARKS
	PUBLICATIONS:
	TEST EQUIP:
	SYSTEM TIME:
	TIME SINCE LAST FAILURE:

Individual Record ✓

BUNO

SUPV: _____

SIGN: _____

Corrective action.

UNIVERSITY OF PENNSYLVANIA
MONITOR DATA SYSTEM
ASSEMBLY DESCRIPTION

Equipment Nomenclature _____ Coded By _____

Organization _____

(1) _____ _____ _____ _____ , Table A _____ Date _____

Equip.Code Unit Code Assembly Code Version

IDENTITY

(2) Mfr. Part No. _____ , (3) Fed. Stock No. _____ ,

(4) Reference Symbol _____ , (5) Fed. Supplier Code _____ ,

(6) Assembly Name _____ , (7) Contract No. _____ ,

(8) Referenced Assembly _____ ,

(9) Assy.Dwg. No. _____ Rev _____ , (10) Date ____/____/____ ,
Yr Mo. Day

(11) Schematic No. _____ Rev _____ , (12) Date ____/____/____ ,
Yr Mo. Day

(13) Next Assy. Dwg. No. _____ Rev _____ , (14) Date ____/____/____ ,
Yr Mo. Day

PHYSICAL DESCRIPTION

(15) Phys. Char. (Table Z) _____ , (16) Module Type _____ , (17) Weight _____ ,lbs

(18) Length _____ , ins (19) Width _____ ,ins (20) Height _____ ,ins

LOGISTICS AND PROVISIONING

	Contractual	Predicted	Actual
MTBF (hours)	(21) _____ ,	(22) _____ ,	(23) _____ ,
MTTR (hours)	(24) _____ ,	(25) _____ ,	(26) _____ ,

(27) Quan/Prime Equip. _____ , (28) Est. Unit Cost _____ ,dollars

(29) Repair Loc. (Table L) _____ , (30) Assignment Source (Table P) ____ , (31) Security _____ ,

(32) ERP/S(ERP Factor) _____ , (33) MRP/N(MRP Factor) _____ ,

ENVIRONMENT

(34) Max. Op. Temp. ± _____ ,°C (35) Min. Op. Temp.± _____ ,°C

ELECTRICAL INTERFACE

(36) Number of Circuits _____ , (37) Number of Active Pins _____ ,

(38) Number of Test Points _____ , (39) Number of Test Connectors _____ ,

PHYSICAL INTERFACE

Conn	Type	Manufacturer	Part Number	Mating Interface	Ckt. Sym.	No. Pins
00	000	//////////	//////////	//////////	//////////	//////
01						
02						
03						
04						
05						

Figure 1a

CIRCUIT DESCRIPTION

Ckt No.	Ckt Function	Ckt No.	Ckt Function	Ckt No.	Ckt Function
01		06		11	
02		07		12	
03		08		13	
04		09		14	
05		10		15	

PIN COUNT

Conn	Pin	Ckt	Conn	Pin	Ckt	Conn	Pin	Ckt	Conn	Pin	Ckt	Conn	Pin	Ckt
00	000	00												

SPECIAL INFORMATION

UNIVERSITY OF PENNSYLVANIA

MONITOR DATA SYSTEM

DATA SHEET

MDS ITEM NO. ______________________ TABLE A ______________

DATA SOURCE ______________________ DATA TYPE ______________

STATE ______

Conn No.	Pin No.	Pin Func.	Code No.	Ref. Pin	Nominal Value	Range	Parameter	Acc. %
0	0	0						

Figure [illegible]

EXHIBIT I B

MAINTENANCE ENGINEERING ANALYSIS RECORD
ASSEMBLY MEAR SUMMARY

1

Nomenclature

Designation / Part Number

Mear Control No.

Contractor

Model

2 Compliance with Applicable Reliability Specification	3 Applic. Accept Repts	4 Design Changes	5 Optional
6 Maintenance Concept	7 Maintainability Evaluation	8 Maintenance Requirements and Tasks	9 Maintenance Resources

10 Next Higher Assy (QN and Nomenclature)	11 Qty Per Assy	Comp	End Art	12 Unit Cost	13 Prod Lead Time	14 ☐ CFE ☐ GFE	15 Pub Code	16 Mec	17 SMR Code

18 Process Spec/DWG	19 Procurement Spec/DWG	20 Design Spec	21 Factors: Maint / Ovhl	22 TAOW / 23 TAT	24 RRR / 25 Par Pool Qty	26 Optional

27 Extent of Maint

- ☐ Fit / Fld Maint — ☐ C ☐ F Kits
- ☐ Govt Overhaul — ☐ C ☐ D Kit
- ☐ Commercial Overhaul
- ☐ Intr Maint — ☐ C ☐ F ☐ D

28 Training Requirements

Personnel	Devices
☐ Not Req	☐ Wep Sys Training
☐ Organizational	☐ Maint Training
☐ Intr Level	☐ Flight Training
☐ Depot Level	☐ Other

29 Status of Doc
- ☐ Avail
- ☐ Ordered

30 Analytical Ovhl
- ☐ Yes
- ☐ No

31 Breakout
- ☐ Yes
- ☐ No

32 Est Ovhl Cost

33 Mear Change Record

Mear Chg No.	Reason for Change	Release By and Date	Mis Review and Date	Govt App and Date

A-45

WR-30

EXHIBIT II

MAINTENANCE CONCEPT

1.

Nomenclature

Designation / Part Number

Mear Control No.

Contractor

Model

2 System Assembly Function

3. Maintenance Concept

4. Reason for Maintenance Concept

A-46

WR-30

EXHIBIT III

MAINTENANCE TIME DISTRIBUTION CHART

1.

Nomenclature

Designation / Part Number

Mear Control No.

Contractor

Model

Man-Minutes Per Flight Hour

0

Inspect — Maint — Daily

Inspect — Maint — Periodic

Sched — Unsched — Remove & Replace

Unsched Maintenance

Legend

System Parameter

Mear Requirements

System Verification

Tot. MMM/FH/OH

WR-30

EXHIBIT IV

MAINTAINABILITY EVALUATION

WR-30

1.

Nomenclature

Designation / Part Number

Mear Control No.

Contractor

Model

2. Consideration	Yes	No	3. Manner of Accomplishment
a. Standardization	☐	☐	a.
b. Diagnostic Aids	☐	☐	b.
c. Accessibility	☐	☐	c.
d. Ease of Removal & Replacement	☐	☐	d.
e. Functional Grouping	☐	☐	e.
f. Work Environment	☐	☐	f.
g. Safety	☐	☐	g.
h. Handling	☐	☐	h.
i. No Maintenance Induced Faults	☐	☐	i.
j. Calibration—Adjustment	☐	☐	j.
k. Sensitivity—Stability—Criticality	☐	☐	k.
l. Human Factors	☐	☐	l.
m. Maintenance Instructions (self contained)	☐	☐	m.
n. Training Requirements	☐	☐	n.
p. Others	☐	☐	p.

4. Maintainability Prediction _____

5. Reliability Prediction _____

EXHIBIT V

RELIABILITY AND DESIGN DATA

Nomenclature

Designation / Part Number

Mear Control No.

Contractor

Model

2 Military Essentiality

Mission Effect		Existence of Redundancy		Existence of Alternatives	
Total (2)	☐	None (2)	☐	None (2)	☐
Partial (1)	☐	Some (1)	☐	Some (1)	☐
None (0)	☐	Complete (0)	☐	Equiv (0)	☐

3 Operating Life

Hrs Retirement Life _____ Source

TBO _____ Source

4 Mean Time Between Failures

Designed _____ Source

Actual _____ Source

Estimated _____ Source

5 Probable Modes of Failure

6 Probable Results of Failure

7 Fail Safe Characteristics

8 Secondary System

9 Failure History

10 Similar or Same Parts in Similar Installation

Part Number	Model Used In	Design Life	Actual MTBF	Difference in Part Application

A-49

WR-30

EXHIBIT VI

MAINTENANCE REQUIREMENTS

MR-30

1

Nomenclature

Designation/Part Number

Mear Control No.

Contractor

Model

2 Req'd No.	Requirement	3 Technical Justification	4 Maint. Type Code	5 Interval	6 Maint. Level	7 Reference Documents

EXHIBIT VII

MAINTENANCE TASKS

1.

Nomenclature

Designation / Part Number

Mear Control No.

Contractor

Model

2. Task No.	3. Task	4. Work Area	5. Task Time	

EXHIBIT VIII

PERSONNEL PLANNING DATA

WR-30

1. _____ Nomenclature

_____ Designation / Part Number

_____ Mear Control No.

_____ Contractor

_____ Model

2. Requirement No.	3. Maint. Level	4. Maint. Type Code	5. Rating	6. MOS / AFSC	7. No. Pers by Skill Level				8. Elapsed Time in Minutes	9. Man Minutes				10. Frequency	11. MMH/FH		12. Remarks
										A. Basic	B. Intermediate	C. Supervisory	D. Total		A. Unscheduled	B. Scheduled	

EXHIBIT VIII A

PERSONNEL PLANNING DATA SUMMARY

1

Nomenclature

Designation / Part Number

Mear Control No.

Contractor

Model

2	3	4	5 Unscheduled MMM/FH				6 Scheduled MMM/FH				7
Maintenance Level	Rating	Mos / AFSC	A. Basic	B. Intermediate	C. Supervisory	D. Total	A. Basic	B.	C. Supervisory	D. Total	Remarks

EXHIBIT X

SUPPORT EQUIPMENT

1. _____ Nomenclature

_____ Designation / Part Number.

_____ Mear Control No.

_____ Contractor

_____ Model

2. Reqmt. No.	3. Part No.	4. Qty	5. Nomenclature	6. Applicable Mear Control No(s).	7. Support Equip. / AGE Reqmt. Sheet No.	8. Remarks

MR-30

EXHIBIT XI

SUPPORT EQUIPMENT REQUIREMENTS SHEET

1

Nomenclature

Designation / Part Number

Mfgr Control No.

Contractor

Model

2 Special Support Equipment ☐ General Support Equipment ☐ Standard Support Equipment ☐

3 Optional

4 Contract Number

5 Optional

6 Support Equipment Nomenclature:

7 Support Equipment Part/Model No.

8 Stock/FSN No.

9 Requirement:

10 Capabilities:

11 Function:

12 Operation:

14 Recommended Item Performs Following "Maintenance Level Function":

15 Based on the Above Maintenance Level Function (MLF), specify below the qty of item required to perform maintenance on a specified quantity of end articles, systems, or components.

MLF	Number of Items Required	Number of End Articles, systems or components	Specific Article, System or Component Involved

(Fill in one line only; unless the item performs multiple MLF)
"C" maintenance level function not applicable to avionics test equipment

18 Further Supporting Data Applicable to, or Attached to This Requirement Sheet

Spec. No.

Work Statement No.

Proposal No.

Dwg. No.

Letter No.

13 Description (As applicable)

Material:

Finish:

Envelope Dimensions:

Weight:

Service Requirements:

19 Source Code

19A ☐ Approved By

BUWEPS. Code

16 Estimated Prices: (If R&D required, omit this block and fill in block 17)

Non-Recurring Costs: $ (Explain)

Recurring Costs: $ Each for (Qty.) Item(s)

17 Research & Development Required ☐ (If checked, complete the following)

Breadboard, Mock-Up or Prototype Required ☐ (Furnish details)

Estimated Engineering Costs: $

Estimated Fabrication & Testing Costs: $ (Explain)

20 Item No.

21 Date

22 Revision No.

23 Page Of

24 Sketch (Separate Sheet)

EXHIBIT XI

NR-30

Nomenclature

Designation / Part Number

Mear Control No.

Contractor

Model

25

A-56

Sketch With Inset of End Item Showing
Area of Use

EXHIBIT XII

MATERIAL LIST

1 Nomenclature

Designation

Mear Control No.

Contractor

Model

2 Requirement & Task No.	3 INDENT	4 Reference Symbol No. (for Electronics Only) Optional for Other	5 Nomenclature	6 Prime Contractor's Part Number	7 Qty. per Assy.	8 Qty. per Comp.	9 Qty. per End Item	10 SHELF LIFE	11 Total Qty. Recm./ Ordered	12 Unit Price Dollars	Cents	Est.*	13 Extended Unit Price Dollars	Cents	Remarks
14 SMR Code		15 Stock Number	16 Item and Lot No.	17 Federal MFR Code	18 Manufacturer's Part Number	Long Part Number Code	19 Recm. Maint. Qty./ Factor	20 Recm. Ovhl. Qty./ Factor	21 Usable on Code	22 Optional	23 Spares Allocations				

25 Contract Number

26 Nomenclature

27 Model/Type No.

28 Contractor

29 Date of List

A-57

MR-30

EXHIBIT XIII

ADDENDUM SHEET

KR-30

1.

Nomenclature

Designation / Part Number

Mear Control No.

Contractor

Model

2.

FAILURE/MALFUNCTION REPORT

1. SHIP NAME, CLASS AND HULL NO.	2. DATE MONTH YEAR	3. REPORT NO
USS BUCK DD761	28 | 07 | 6	AK7001

4. REPAIR ACTIVITY	5. WORK CENTER	6. EQUIP. I.D. CODE	7. SERIAL NO. & MFR.	8. HOW MAL. CODE
PHILA. N.S.Y	390/51	FE 04303		

9. PRIMARY OR SECONDARY	10. DISC	11. STATUS AFTER FAILURE	12. ENVIRONMENT
		A3 32 C1	

13. ACTIVE REPAIR TIME						14. LOG DOWNTIME	15. AD DOWNTIME
13a. TI	TD	TINT	TR	TA	TC		

16 TOTAL EQUIP. DOWNTIME	17. TOTAL OP. TIME	18. SERIAL NO. & MFR. OF REPLACEMENT

19. NARRATIVE REMARKS & RECOMMENDATIONS

20. CID/APL/AN

21. SOURCE CODE	22. FEDERAL STOCK NO./PART NO.	23. REFERENCE SYMBOL/NOUN	24. MATERIAL USED UNITS	24. MATERIAL USED QUANITY	25. UNIT PRICE

26. SIG. OF SUPPLY PERS.	27. SIG. OF REPAIRMAN	28. SIG. OF REPAIRMAN SUPT.

Figure I

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REPORT OF EQUIPMENT FAILURE
NAVSHIPS 3021 (REV. 6-55)

REPORT BUSHIPS-5120-1

1. SHIP TYPE	2. HULL NUMBER	3. DATE OF FAILURE (MONTH, DAY, YEAR)	4. DATE OF LAST FAILURE (MONTH, DAY, YEAR)
CVA	41	5 JAN 1966	15 JAN 1960

A. NAME OF FAILED COMPONENT: #2 DC/MG SET

5. COMPONENT ALLOWANCE GROUP NUMBER:

6. COMPONENT IDENTIFICATION NO. (CID): 15140135

B. COMPONENT MANUFACTURER'S NAME: GENERAL ELECTRIC

7. MANUFACTURE SERIAL NUMBER: 402 YK

8. NUMBER OF MAINTENANCE CHECKS SINCE LAST FAILURE	9. DID COMPONENT FAIL IN OPERATION?	10. OPERATIONAL HOURS SINCE COMPONENT LAST FAILURE:
UNKNOWN	☒ YES ☐ NO	UNKNOWN

C. CAUSE OF FAILURE (CHECK ONE)

1. ☐ BROKEN OR CRACKED PART	5. ☐ FAILURE OF WELD	9. ☐ LOOSE CONNECTION	13. ☐ LEAK
2. ☐ EXCESSIVE PART CLEARANCE	6. ☐ LACK OF LUBRICATION	10. ☐ INSULATION FAILURE	14. ☐ FUNGUS
3. ☐ FAILURE OF CONTROL	7. ☐ IMPROPERLY INSTALLED	11. ☐ WATER	15. ☐ CORROSION
4. ☐ FOREIGN MATTER	8. ☐ EXCESSIVE HEAT	12. ☐ VIBRATION	16. ☒ UNKNOWN

17. ☐ OTHER (SPECIFY):

PART DATA

D. NAME OF PART THAT FAILED	E. MATERIAL OF WHICH PART IS MADE	F. HOURS OPERATIVE	G. PART NO. (Use Only One: Federal Stock No., Bureau Plan & Piece No., or Mfg. No.)
RT-8 DIODE	GERMANIUM	UNKNOWN	4JA2A2

H. REMARKS AND RECOMMENDATIONS

GIVE DESCRIPTION OF FAILURE, ELABORATE ON CAUSE AND/OR REMEDY APPROPRIATE. GIVE RECOMMENDATIONS TO PREVENT RECURRENCE OF FAILURE:

TROUBLE CALL INDICATED MG SET OUTPUT WAS 40 VOLTS
INVESTIGATION SHOWED NO CONTROL OF OUTPUT VOLTAGE.
WHILE TROUBLE SHOOTING WE FOUND RT-8 SHORTED.
REPLACED SAME. TESTED OUT SATISFACTORY

SIGNED: L. [illegible] Lt

DATE: 6/7/66

REPORT THE FAILURE OF ONLY ONE PART OR TUBE ON THIS FORM

1. REPORT NO.	2. REPORTING ACTIVITY	3. REPAIRED OR REPORTED BY (NAME)	4. DATE OF FAILURE
5. EQUIPMENT INSTALLED IN (TYPE AND NO.)	6. TIME METER READING OR INSTALLATION LOG TIME	7. WAS MISSION ABORTED? ☐ YES ☐ NO	8. OPERATIONAL CONDITION

EQUIPMENT	9. MODEL DESIGNATION AND MOD. NO.	10. SERIAL NO.	11. CONTRACTOR	12. CONTRACT OR ORDER NO.
COMPONENT (MAJOR UNIT)	13. MODEL DESIGNATION AND MOD. NO.	14. SERIAL NO.	15. CONTRACTOR	16. CONTRACT OR ORDER NO.
ASSEMBLY OR SUBASSEMBLY	17. ASSEMBLY AND MOD. NO.	18. SERIAL NO.	19. MANUFACTURER	20. (LEAVE BLANK)

PART DATA	21. PART NAME OR TUBE TYPE	22. STOCK NO. (FAILED ITEM)	23. PART REF. DESIG. (V-101, R-101, ETC.)	24. REPAIR TIME (MAN-HOURS)
	25. HOURS IN SERVICE	26. MANUFACTURER OF FAILED PART	27. SERIAL NO.	28. WAS REPLACEMENT PART AVAILABLE LOCALLY ☐ YES ☐ NO

29. FIRST INDICATION OF TROUBLE

1	☐	INOPERATIVE
2	☐	INTERMITTENT
3	☐	LOW PERFORMANCE
4	☐	NOISY
5	☐	OFF FREQUENCY
6	☐	OUT OF ADJUSTMENT
7	☐	OVERHEATING
8	☐	UNSTABLE
9	☐	OTHER

30. CHECK TYPE(S) OF TUBE OR PART FAILURE

007	☐	ARCING	001	☐	GASSY	790	☐ OUT OF ADJUST.
710	☐	BEARING FAILURE	300	☐	GROUNDED	006	☐ SHORTED
780	☐	BENT	380	☐	LEAKAGE	770	☐ SLIP RING OR COMMUTATOR FAILURE
040	☐	BINDING	730	☐	LOOSE		
070	☐	BROKEN	004	☐	LOW GM OR EMISSION	018	☐ TESTED OK DID NOT WORK
720	☐	BRUSH FAILURE	750	☐	MISSING		
080	☐	BURNED OUT	008	☐	NOISY	020	☐ WORN EXCESSIVELY
130	☐	CHANGED VALUE	450	☐	OPEN		☐ SEE INSIDE FLAP FOR ADDITIONAL CODES
170	☐	CORRODED	099	☐	OTHER		

31. CAUSE OF FAILURE

2	☐	FAULTY PACKAGING
5	☐	MISHANDLING
6	☐	INSPECTION OR TEST
1	☐	NORMAL OPERATION
3	☐	STORAGE
7	☐	ASSOCIATED FAILURE-EXPLAIN
4	☐	OTHER

32. WAS THE PART REPLACED DURING PREVENTIVE MAINTENANCE? ☐ YES ☐ NO

33. REMARKS *(Continue on reverse side if necessary)*

DD (1 AUG 54) 787 **ELECTRONIC FAILURE REPORT**

A15907

Figure 1. Electronics Failure Report DD-787 Currently Used by BuShips

BUSHIPSINST 10550.73A
7 October 1964

ELECTRONIC EQUIPMENT OPERATIONAL TIME LOG
MONTHLY SUMMARY REPORT

NAVSHIPS 4855-1

BUSHIPS RPT 10550-14

1. Month	2. Year	3. Name of Activity/Ship	4. Activity Code/Ship Designation & Hull No.
July	1964	NAVCOMMSTA	2476-690

5. Equipment Nomenclature	6. Serial Number	7. Standby Time On (hrs)	8. Fully Energized Time On (hrs)	9. Date & Time of Operational Failures	
				Date	Time (ZULU)
AN/FRT-38	101	114	630	6/30	0822
AN/FRT-39B	138	247	483		
AN/GRD-6	A15	0	741	6/15	1530
AN/GRC-27A	704	0	744		
AN/GRC-27A	760	0	744		
AN/UGC-15	54	0	744		
AN/UGC-15	56	0	741	6/2	1130
AN/URA-17	A181	0	0		
AN/URA-17	A270	0	744		
AN/URA-17	A280	0	740	6/8	1820
AN/URT-7	460	0	732.5	6/3 6/15	1750 0930
CU-691/URR	175	0	744		
CU-691/URR	203	0	625	6/1 6/7 6/18	2250 0130 1420

Encl (2)

ELECTRONIC PERFORMANCE & OPERATIONAL REPORT
NAVSHIPS 3878 (Rev. 4-60)
Submit original only to Bureau - No forwarding letter required

REPORT-BUSHIPS-9670-1

FROM: USS HALEAKALA (AE-25) *(Ship name, type and hull no.)*
☐ LANT ☒ PAC FLEET
TO: CHIEF, BUREAU OF SHIPS (CODE)

REPORT CLASSIFICATION: UNCLASSIFIED
DATE: 1 MARCH66
REPORTING PERIOD: FROM 1 FEB 66 TO 28 FEB 66

TYPE AND MODEL OF EQUIPMENT: R-1051/URR
SERIAL NUMBER: B-497

FIELD CHANGES TO DATE: ACCOMPLISHED: ALL NONE; NOT ACCOMPLISHED:
HOURS DURING PERIOD OF THIS REPORT: OPERATED 672; NOT IN OPERATING CONDITION 0

PERFORMANCE FIGURE (PF) & TECHNICAL EVALUATION: ☒ OUTSTANDING ☐ GOOD ☐ SATISFACTORY ☐ UNSATISFACTORY
OPERATIONAL EVALUATION: ☒ OUTSTANDING ☐ GOOD ☐ SATISFACTORY ☐ UNSATISFACTORY

RADAR

PEAK POWER OUTPUT (PT) dbm		AVER. VSWR IN TRANSMISSION LINE		AVER. ECHO BOX RING TIME YDS		MIN. DISCERNIBLE SIGNAL (PMDS) dbm	
MAX. RANGE TARGETS DETECTED	MI	MI	MI	MAX. ALTITUDE AT RANGE DETECTED	MI	MI	MI
MAX. ALTITUDE TARGETS DETECTED	FT	FT	FT	RANGE AT MAX. ALTITUDE DETECTED	FT	FT	FT
TARGET CLASS., TYPE - DETAIL (SEE REVERSE)				TARGET CLASS. TYPE - DETAIL (SEE REVERSE)			
MAXIMUM RELIABLE RADAR RANGE MI				MINIMUM RELIABLE RADAR RANGE YDS			

SONAR

SOURCE LEVEL (LS) db//uBAR	RECEIVING SENSITIVITY db//VOLT/uBAR		SEA STATE		PROCEDURE USED	
NOISE LEVEL db//VOLT	5 KNOTS	10 KNOTS	15 KNOTS	20 KNOTS	25 KNOTS	30 KNOTS
MAXIMUM RANGE SONAR TARGETS DETECTED AND TRACKED	RANGING YDS		LISTENING YDS		SOUNDING FATHOMS	
TARGET CLASSIFICATION TYPE AND DETAIL						
BT PATTERN						
OWN SHIP'S SPEED.	KTS		KTS		KTS	

COMMUNICATIONS

PERCENT OF TIME OUT OF CONTACT WHILE WITHIN RANGE (IF ANY): NONE NOTED

ANTENNA SYSTEMS: ANTENNA PATCH PANEL:
75' WIRE
50' WIRE
35' WHIP

INTERFERENCE *(Frequencies, intensity, and sources)*: NONE NOTED

ELECTRONIC WARFARE

POWER OUTPUT	NA WATTS		AVERAGE VSWR	NA	REL RANGE	NA	RECEIVER SENSITIVITY	1 UVOLTS
MAXIMUM RANGE AND ALTITUDE TARGETS WERE DETECTED	MI	FT	MI	FT	MI	FT		
TARGET CLASSIFICATION TYPE AND DETAIL (SEE REVERSE SIDE)								
MAXIMUM RELIABLE RANGE AND ALTITUDE	MI	FT	MI	FT	MI	FT		
TARGET CLASSIFICATION TYPE AND DETAIL (SEE REVERSE SIDE)								
MAX. RANGE SONAR TARGETS DETECTED YDS		BT PATTERN		MAX. RELIABLE SONAR RANGE YDS		BT PATTERN		

TARGET CLASSIFICATION

TYPE	DETAIL
1. Large Plane (Bomber)	a. Own Ship's controlled aircraft
2. Small Plane (Jet Fighter)	b. An alerted aircraft approach or contact (An aircraft whose existence and location is known prior to being picked up on own radar)
3. Group of Planes	
4. Merchant Ship	
5. Warship	c. An unalerted aircraft approach or contact (An aircraft whose existence was not previously known)
6. Formation of Ships	
7. Submarine	d. An opening aircraft contact
8. Buoy	e. An anticipated surface contact
9. Weather Front	f. An unanticipated surface contact
10. Land	g. Snorkling
11. Other (Explain)	h. Submerged
12. Unknown	i. Other (Explain)
	j. Unknown

OUTAGE REMARKS: (Account for time equipment was NOT in operating condition. Show casualty, corrective action, outage time and comments. Include time inoperative for preventive maintenance and POMSEE. Reference Casualty Report, if one submitted on this equipment during this reporting period)

4 HOURS FOR PMS

GENERAL REMARKS: (Comment on any problems or inadequacies encountered in the equipment. Comment is also desired on any item above or any item not covered by this report. When detailed tracking data is available and the equipment can be evaluated operationally, comment on such items as reliability, target discrimination and clarity. If overheating occurs report ambient and equipment temperature in degree. If equipment is considered to be operating satisfactorily, so state.) (Problem areas listed below are for convenience.)

- Antenna
- Cabling (including wave guides)
- Design
- Electrical
- Interference
- Lubrication
- Maintenance
- Mechanical
- Overheating
- Power input
- Physical operation
- Safety devices
- Spare parts
- Test equipment
- Test points
- Transducer
- Tube failures
- Vibration
- Logistic support (Manuals, repair activities, overhaul, etc)

EQUIPMENT HAS BEEN OPERATING SATISFACTORILY

SIGNATURE: L. R. Simmons ET1V3

CLASSIFICATION (Of this report): UNCLASS

0-48007

Report Symbol BUWEPS 13070.1

1. Reporting Activity	2. Report Ser. No.	3. Date Of Trouble	4. Installed In Aircraft/Arrest. Gear/Catapult/Support Equipment Model / Buno or Ser. No.	5. Aircraft Logbook Time

	6. Model Designation And Model No.	7. Nomenclature	8. Serial No.	9. Time Meter Read./Logbook Time or Events (if applicable) Hour meter / Logbook hrs. / Starts / Landings
System, Set Equipment Or Engine				

	10. Manufacturer's Part No.	11. Nomenclature	12. Serial No.	13. Mfr's Code No. / 14. Contract No.	15. Time Or Events Hrs. / Starts / Ldg's
Unit, Component Accessory, Assembly Or Equipage					

	16. Manufacturer's Part No.	17. Nomenclature	18. Serial No.	19. Mfr's Code No.	20. Location (if applicable)
Subassembly (Electronic) Or Primary Part Failure (Non-electronic)					

	21. Federal Stock Number	22. (RM, MR copies only)	23. Quantity	24. (RM, MR copies only)	25. (RM, MR copies only)
Supply Identification Item(s) Returned					

Reason For Report (Check one)

26. Removal Or Maintenance Action Required As A Result Of:

1 ☐ Failure/ Suspected Failure Or malfunction
2 ☐ Damaged due To improper Maintenance/ Operation/Test
3 ☐ Damaged or Defective On receipt
4 ☐ Damaged Accidentally
5 ☐ Scheduled/Directed Removal, high time Overage, excess To requirements

27. Item overhauled by

DESCRIPTION OF TROUBLE

(If box 1, 2, 3, or 4 was checked in space 26, complete spaces 28 through 31. If box 5 was checked in space 26, leave spaces 28 through 31 blank.)

28. First Observed/Occurred During

1 ☐ Flight operations—Land based
2 ☐ Flight operations carrier based
3 ☐ Pre-flight
4 ☐ Daily
5 ☐ Conditional
6 ☐ Calendar
7 ☐ Overhaul/PAR
8 ☐ Shop maintenance bench test
9 ☐ Special directed inspection
10 ☐ Normal operation of support equip., catapults, arresting gear, mirror landing sys. only.

29. Symptoms—How Discovered — Item

A ☐ Excessive vibration
B ☐ High fuel consumption
C ☐ High oil consumption
D ☐ Incorrect display
E ☐ Inoperative
F ☐ Interference/Binding
G ☐ Intermittent operation
H ☐ Leakage
I ☐ Low performance
J ☐ Metal in oil
K ☐ Noisy
L ☐ None noticed
M ☐ Out-of-balance
N ☐ Overheating
O ☐ Pressure out-of-limits
P ☐ RPM out-of-limits
Q ☐ Surging/Fluctuates
R ☐ Temperature out-of-limits
S ☐ Torque out-of-limits
T ☐ Unstable operation
U ☐ Visible defect
V ☐ Other (Amplify)

30. Part Condition

007 ☐	Arced	130 ☐	Changed value	201 ☐	Distorted/Stretched	750 ☐	Missing	585 ☐	Sheared
780 ☐	Bent	910 ☐	Chipped/Nicked	148 ☐	Eroded	008 ☐	Noisy	196 ☐	Shorted/Grounded
135 ☐	Binding	999 ☐	Circuit defective	250 ☐	Frayed/Torn	450 ☐	Open	422 ☐	Soldering defect
429 ☐	Blistered/Peeled	160 ☐	Connections defective	001 ☐	Gassy	790 ☐	Out-of-adjustment	660 ☐	Stripped
070 ☐	Broken/Cracked	818 ☐	Contacts Burned/ Pitted	381 ☐	Leaking	439 ☐	Plugged/Clogged	018 ☐	Tested OK—Did not work
900 ☐	Burned/Burned out	170 ☐	Corroded	730 ☐	Loose	576 ☐	Ruptured/Split/Blown	389 ☐	Unknown (Cannot disassemble)
120 ☐	Chafed/Galled	200 ☐	Dented	004 ☐	Low GM or emission	935 ☐	Scored	020 ☐	Worn—Excessively
								099 ☐	Other (Amplify)

31. Cause Of Trouble

A ☐ Design deficiency
B ☐ Faulty maintenance (Quality Control)
C ☐ Faulty manufacturing (Quality Control)
D ☐ Faulty overhaul (Quality control)
E ☐ Faulty preservation/ Packaging
F ☐ Foreign object
G ☐ Fluid contamination
H ☐ Installation environment (Location in weapons sys.)
I ☐ No failure-replaced to improve sys. performance
J ☐ Operator technique/ Adjustment
K ☐ Other parts primary cause
L ☐ Undetermined (Cannot disassemble)
M ☐ Weather conditions
N ☐ Wrong part installation
O ☐ Other (Amplify)

32. DISPOSITION OR CORRECTIVE ACTION: Select appropriate code(s) from list below and enter in boxes at left to indicate disposition or corrective action taken with respect to each of the items entered in spaces 6, 10, and 16.

Space 6 ☐
Space 10 ☐
Space 16 ☐

Replaced And Returned To Supply

Code	Reason
A	Hold 90 days
B	Lack of repair facilities
C	Lack of repair parts
D	Lack of Tech. Pubs.
E	Lack of personnel
F	Beyond assigned maintenance level
G	Other—(Defective on receipt, high time, directed removal, excess to requirements, etc.)

Code	Corrective Action
H	Used as is
I	Adj./Realign./Serv./Repaired in place
J	Removed-Adj./Realign./Serv./ Repaired-reinstalled
K	Removed-repaired-made RFI
L	Removed-tested Ok-made RFI
M	Removed-scrapped
N	Surveyed
O	Released for investigation and replaced (Indicate custody in space 35)

33. Maintainability Information

	Hours	Tenths
Man-hours to locate trouble Space 10		
Man-Hours to locate trouble Space 16		
Man-hours to repair/replace/adjust		
Actual time A/C was undergoing repair		
Total time aircraft not flyable due to this malfunction		

ACCESSIBILITY
S ☐ Satisfactory
U ☐ Unsatisfactory (Amplify)

SPECIAL
1 ☐ Frequent trouble item
2 ☐ Can be installed wrong (Amplify)

34. Component/Assembly, Subassembly Replaced With:

Mfr's Part No.

Serial No.

Mfr's Code No.

35. AMPLIFYING REMARKS (Furnish additional information concerning failure or corrective action not covered above. Do not merely repeat information checked above. Specify any severe operating conditions, such as hard landings, wheels-up landings, severe maneuvers, etc.)

36. Report Is:
0 ☐ FUR
1 ☐ AMPFUR
2 ☐ Urgent AMPFUR
3 ☐ Flight Safety AMPFUR
4 ☐ Follow up report

Signature | Rank/Rate | Date

Associated Parts Repaired Or Replaced (Do not list any item reported above)	37. Part No. (Non-electronic parts) Or Part Ref. Designator (Electronic parts)	38. Part Name, Tube Type, Semi-Conductor Type Or Description	39. Mfr's Code No.	40. Failure Code (From space 30)	41. Disposition (Code from space 32)

42. Activity Repaired By

Signature

Rank/Rate | Date

FAILURE, UNSATISFACTORY OR REMOVAL REPORT
NAVWEPS FORM 13070/3 (10 62)

(Mail this copy to NATSF)

FUR

WEAPON SYSTEMS COMPONENT FAILURE REPORT
NAVWEPS FORM 8000-13/2-82

TO: COMMANDING OFFICER, U.S. NAVAL AMMUNITION DEPOT (QEL)
CONCORD, CALIFORNIA

REPORT SYMBOL NAVWEPS 8000-13

NOTE: NO CARBON PAPER REQUIRED

1. SHIP OR STATION	2. DATE AND TIME OF FAILURE	3. LOCATION	4. NAME OF ACTIVITY ACCOMPLISHING REPAIR OR MAINTENANCE ACTION	5. SIGNATURE OF PERSON DIAGNOSING TROUBLE OR FILLING OUT REPORTS AND DATE (2.)	6. RATE

SECTION I - FAILURE EVENT DATA

7. NAME AND MK MOD DESIGNATION OF FIRE CONTROL OR WEAPON SYSTEM	10. SERIAL NO.	13. CONTRACTOR
8. AN OR MK MOD DESIGNATION OF EQUIPMENT OR SET	11. SERIAL NO.	14. CONTRACTOR
9. MIL NOMENCLATURE OR NAME OF COMPONENT ASSEMBLY	12. SERIAL NO.	15. CONTRACTOR

18. MAINTENANCE TIME EXCLUSIVE OF IDLE TIME	CLOCK HOURS	MAN HOURS
DIAGNOSIS	(a)	(b)
REPAIR	(c)	(d)

19. WAS THIS A PREVENTIVE MAINTENANCE EVENT? ☐ YES ☐ NO

16. DID EQUIPMENT FAIL WITHIN 5 MINUTES OF TURN-ON?	17. EQUIPMENT DOWN TIME (TOTAL HRS.)	20. EQUIPMENT STATUS AT FAILURE FROM NAVWEPS FORM 8821/5 (FOR SAM SYSTEMS ONLY)
☐ YES ☐ NO		☐

21. CONDITION OF EQUIPMENT (2.)	AT FAILURE	AFTER MAINTENANCE
1. FULLY OPERABLE	☐	☐
2. REDUCED CAPABILITY	☐	☐
3. INOPERATIVE	☐	☐

22. TIME METER READINGS	STANDBY	OPERATE
1. FOR ITEM IN BLOCK 9		
2. OTHER TIME METER READINGS (EXPLAIN UNDER "REMARKS")		

23. EQUIPMENT FAILED DURING (CHECK ONE)
- ☐ ROUTINE MAINTENANCE INSPECTION
- ☐ DRILL, TRANSMISSION CHECKS, SYSTEM TEST
- ☐ FIRING
- ☐ NORMAL OPERATION
- ☐ HANDLING ACCIDENTAL DAMAGE
- ☐ SHIPYARD OVERHAUL
- ☐ STANDBY OPERATION
- ☐ INSTALLATION AND CHECKOUT
- ☐ OTHER EXPLAIN UNDER "REMARKS"

24. CAUSE OF TROUBLE (CHECK ONE)
- ☐ INADEQUATE MAINTENANCE
- ☐ PRIME POWER SURGE
- ☐ OPERATOR TECHNIQUE/ADJUSTMENT
- ☐ RESULT OF ASSOC./OTHER EQUIPMENT FAILURE
- ☐ WEATHER CONDITION
- ☐ FAULTY PRESERVATION/PACKAGING
- ☐ DETERIORATION/OVERAGE/STORAGE
- ☐ UNDETERMINED
- ☐ OTHER, EXPLAIN UNDER "REMARKS"

25. SYMPTOMS INDICATING TROUBLE (CHECK ONE)
- ☐ VISUAL DEFECT
- ☐ INOPERATIVE
- ☐ INTERMITTENT OPERATION
- ☐ LOW PERFORMANCE
- ☐ LEAKAGE
- ☐ INTERFERENCE/BINDING
- ☐ OUT-OF-BALANCE
- ☐ EXCESSIVE VIBRATION
- ☐ UNSTABLE OPERATION
- ☐ NOISY
- ☐ INCORRECT PRESENTATION
- ☐ SURGING/FLUCTUATES
- ☐ TORQUE OUT-OF-LIMITS
- ☐ PRESSURE OUT-OF-LIMITS
- ☐ TEMPERATURE OUT-OF-LIMITS
- ☐ FOREIGN OBJECTS IN OIL
- ☐ OVERHEATING
- ☐ OTHER, EXPLAIN UNDER "REMARKS"

26. CORRECTIVE ACTION/DISPOSITION (CHECK ONE)
- ☐ REPAIRED
- ☐ REPLACED
- ☐ ADJUSTED
- ☐ MODIFIED/ALTERED
- ☐ CLEANED
- ☐ ORDALT
- ☐ SERVICED/LUBRICATED
- ☐ SURVEYED
- ☐ OTHER, EXPLAIN UNDER "REMARKS"

SECTION II - COMPONENT PARTS DATA (LIST ALL PARTS REPLACED, REPAIRED OR ADJUSTED)

27. UNIT DESIG. NO., NOMENCLATURE, OR NAME OF ITEM WHICH CONTAINS ALL OF THE MAINTENANCED PARTS	28. SERIAL NUMBER	29. CONTRACTOR

30. PART NAME OR TUBE TYPE	31. FEDERAL STANDARD STOCK OR DRAWING NO.	32. PART REF. DESIGNATION V2, R1, ETC.	33. LOWEST DESIGNATED UNIT OR SUBASSEMBLY	34. SERIAL NO. OF ITEM IN BLOCK 33	35. PART FAILURE IS PRIM.	35. PART FAILURE IS SEC.	36. MFR. OF ITEM	37. ACTION (CHECK ONE PER PART) REPAIR	37. ACTION ADJUST	37. ACTION REMOVE	38. DEFECT CODE (SEE REVERSE)
					☐	☐		☐	☐	☐	
					☐	☐		☐	☐	☐	
					☐	☐		☐	☐	☐	
					☐	☐		☐	☐	☐	
					☐	☐		☐	☐	☐	

39. REMARKS (DESCRIBE SYMPTOMS, DIAGNOSIS, ACTION TAKEN, TEST RESULTS, ADJUSTMENTS, DISPOSITION OF PARTS, EQUIPMENT PERFORMANCE, RECOMMENDATIONS, AND ANY ADDITIONAL INFORMATION THAT IS NOT ADEQUATELY COVERED BY CHECK BOXES. ATTACH PHOTOS, SKETCHES OR DIAGRAMS AS APPROPRIATE.)

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NAVWEPS FORM 8000/23 (11-62) — [illegible] TIME METER REPORT — (See instructions on back) — REPORT SYMBOL BUWEPS 8000-23

REPORTING ACTIVITY

REPORT FOR (Month and year)

AN NOMENCLATURE/NAME AND MK AND MOD NO. OF EQUIPMENT (1)	SERIAL NO. (2)	LOCATION OF TIME METER (3)	DESIGNATION OF TIME METER (4)	TIME METER READING (5)	DATE (6)

METER REPLACEMENT DATA (7)

REMOVED METER						
NEW METER						

A. JOB CONT NO.	B. PRI	C. TIME SPEC REQ	D. WK AREA	E. EST M/H	F. ORIG RPT NO.	G. REPORT NO. 83707 N				H.		I.
1. WEAPON TMS C130A	2. SERIAL NO. 59-743	3. TIME 1517	4. WORK CENTER Q4210	5. WORK ORDER NO. AB	9743	CF	6. DAY NO. TA. 18	06	2	7. WORK UNIT CODE 4211		
1A. AGE WUC	2A. SERIAL NO.	3A. TIME	8. ACT TAKEN R	9. WHEN DIS D	10. HOW MAL 242	11. UNITS 1	12. LABOR HRS. 2.3			13. ASST. WORK CTR Q3110		
1B. ENG TM PSN	2B. SER MOD YR-MFG SER NO.	3B. TIME	14. INST ENG TM PSN	15. SER MOD YR-MFG SER NO.						16. TIME		
1C. ITEM FSC	2C. PART NO.	3C. SERIAL NO.	17. INST ITEM PT NO.	18. SERIAL NO.						19. TIME		

J. SYMBOL	K. DISCREPANCY	L. CORRECTIVE ACTION
M	GENERATOR INOPERATIVE	DEFECTIVE GENERATOR
	#3 ENG.	REMOVED AND REPLACED.

CORRECTED BY-SIGNATURE & GRADE: W. Mc Cullough SSgt

DISCOVERED BY-SIGNATURE & GRADE: K. Barnes A2C

INSPECTED BY-SIG & GRADE:

SUPERVISOR-SIG & GRADE: B. Snavely MSgt

RECORDS ACTION: ☐ UNCLEARED DISCREPANCY ☐ REPLACEMENT TIME CHANGE ITEM ☐ DATA TRANSCRIBED TO APPROP RECORDS

DATE TRANSCRIBED:

TRANSCRIBED BY-SIGNATURE & GRADE:

AFTO FORM OCT 61 211 — JUL 60 EDITION IS OBSOLETE JUL 61 EDITION MAY BE USED — MAINTENANCE DISCREPANCY/PRODUCTION CREDIT RECORD — 1

Figure 9-3.

I W/C CONT

A. JOB CONTROL NO. | B. PRIORITY | C. TIME SPECIALIST REQ. | D. EST M/H | E. WORK LOCATION | F.

II STATISTICAL DATA

1. WEAPON TMS	2. SERIAL NO.	3. TIME	4. WORK CENTER	5. WORK ORDER NO.		6. DATE DAY	MON	YR
B 527	57-068	915	Q 2140	AT	7068 EL	20	10	1

1A. AGE WUC	2A. SERIAL NO.	3A. TIME	7. TCTO IDENTIFICATION	10. COMPL STATUS	11. UNITS COMPL	12. TOTAL LABOR HOURS
			0114937	801	1	22 3

1B. ENGINE T/M	PSN	2B. SER MOD YR-MFG SER NO.	3B. TIME	13. ABSIS WORK CENTER	G.	H.

1C. ITEM FSC	2C. PART NO.	3C. SERIAL NO.	I.	J.	K.

III SUP DATA

L. TCTO KIT STOCK NO.	M. DATE REQUISITIONED	N. VOUCHER NO.	O. KIT ISSUED BY	P. KIT ISSUED/DELIVERED TO
1560-K-0114937	5 Jul 61	2300-0185-4763	V. FISHER	R. GRIMES

IV MAINTENANCE ACTIONS

Q. SYM	R. REMARKS
P	C/W T.O. 1B-52-1329 dtd 30 June 61 -- Revision of Escape Hatch Lifter.
	T.O. C/W

ACCOMPLISHED BY - SIGNATURE & GRADE: J. Lemons A1C

INSPECTED BY - SIGNATURE & GRADE: R. Lunn MSgt

SUPERVISOR - SIGNATURE & GRADE: R. Bess SMS

V REC UNIT

COMPLIANCE RECORDED ON HISTORICAL RECORDS: ☑ WEAPON ☐ AGE ☐ ENGINE ☐ APPROPRIATE EQUIPMENT

DATE TRANSCRIBED: 21-10-1

TRANSCRIBED BY - SIGNATURE & GRADE: J. Kotulak SSgt

AFTO FORM JUL 61 212 — PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE — TIME COMPLIANCE TECHNICAL ORDER WORK RECORD — M&W, INC. 8-61 10MM

Figure 9-4.

Flight Line

A. JCB CONT NO.	B. PRI	C. TIME SPEC REQ	D. WK AREA	E. EST M/H	F. ORIG RPT NO.	G. REPORT NO.	H.	I.
–	✓	✓	✓	✓	–	Nº 027398		

1. WEAPON TMS	2. SERIAL NO.	3. TIME	4. WORK CENTER	5. WORK ORDER NO.	6. DAY MO. YR	7. WORK UNIT CODE
✓	–	✓				✓

1A. AGE WUC	2A. SERIAL NO.	3A. TIME	8. ACT TAKEN	9. WHEN DIS	10. HOW MAL	11. UNITS	12. LABOR HRS	13. ASST. WORK CEN
		✓	✓	✓	✓			

1D. ENG TM PSN	2D. SER MOD YR-MFG SER NO.	3B. TIME	14. INST ENG TM PSN	15. SER MOD YR-MFG SER NO.	16. TIME

1C. ITEM FSC	2C. PART NO.	3C. SERIAL NO.	17. INST ITEM PT NO.	18. SERIAL NO.	19. TIME

J. SYMBOL	K. DISCREPANCY	L. CORRECTIVE ACTION
		CORRECTED BY-SIGNATURE & GRADE
	DISCOVERED BY-SIGNATURE & GRADE	INSPECTED BY-SIG & GRADE / SUPERVISOR-SIG & GRADE
RECORDS ACTION ☐ UNCLEARED DISCREPANCY ☐ REPLACEMENT TIME CHANGE ITEM ☐ DATA TRANSCRIBED TO APPROP RECORDS		DATE TRANSCRIBED / TRANSCRIBED BY-SIGNATURE & GRADE

AFTO FORM JUL 61 210 PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE

MAINTENANCE DISCREPANCY/PRODUCTION CREDIT RECORD

20. PARTS REPLACED DURING REPAIR

FSC	PART NUMBER	WORK UNIT CODE	REF SYM	MCW MAL	QTY

GATLING BUSINESS FORMS CO., INC., NORFOLK, VA.

PRESS HARD. YOU ARE WRITING FOUR (4) COPIES

MCGREGOR & WERNER, INC., DAYTON, OHIO S-63 10MM

A. JOB CONT NO.	B. PRI	C. TIME SPEC REQ	D. WK AREA	E. EST M/H	F. ORIG RPT NO.	G. REPORT NO. 5650C2	H.	I.

1. WEAPON MDS	2. SERIAL NO.	3. TIME	4. WORK CENTER	5. WORK ORDER NO.	6. DAY MO. YR / /	7. WORK UNIT CODE

1A. END ITEM WUC	2A. SERIAL NO.	3A. TIME	8. ACT TAKEN	9. WHEN DIS	10. HOW MAL	11. UNITS	12. LABOR HRS	13. ASST. WORK CEN

1B. ENG TM PSN	2B. SER MOD YR-MFG SER NO.	3B. TIME	14. INST ENG TM PSN	15. SER MOD YR-MFG SER NO.	16. TIME

1C. ITEM FSC	2C. PART NO.	3C. SERIAL NO.	17. INST ITEM PT NO	18. SERIAL NO.	19. TIME

J. SYMBOL	M. SUPPLY (ISSUE OR DEMAND) DOCUMENT NUMBER	L. CORRECTIVE ACTION
K. DISCREPANCY		
		CORRECTED BY-SIGNATURE & GRADE
	DISCOVERED BY-SIGNATURE & GRADE	INSPECTED BY-SIG & GRADE / SUPERVISOR-SIG & GRADE
RECORDS ACTION ☐ UNCLEARED DISCREPANCY ☐ REPLACEMENT TIME CHANGE ITEM ☐ DATA TRANSCRIBED TO APPROP RECORDS		DATE TRANSCRIBED / TRANSCRIBED BY-SIGNATURE & GRADE

AFTO FORM APR 65 211 OCT 61 EDITION WILL BE USED

MAINTENANCE DISCREPANCY/PRODUCTION CREDIT RECORD

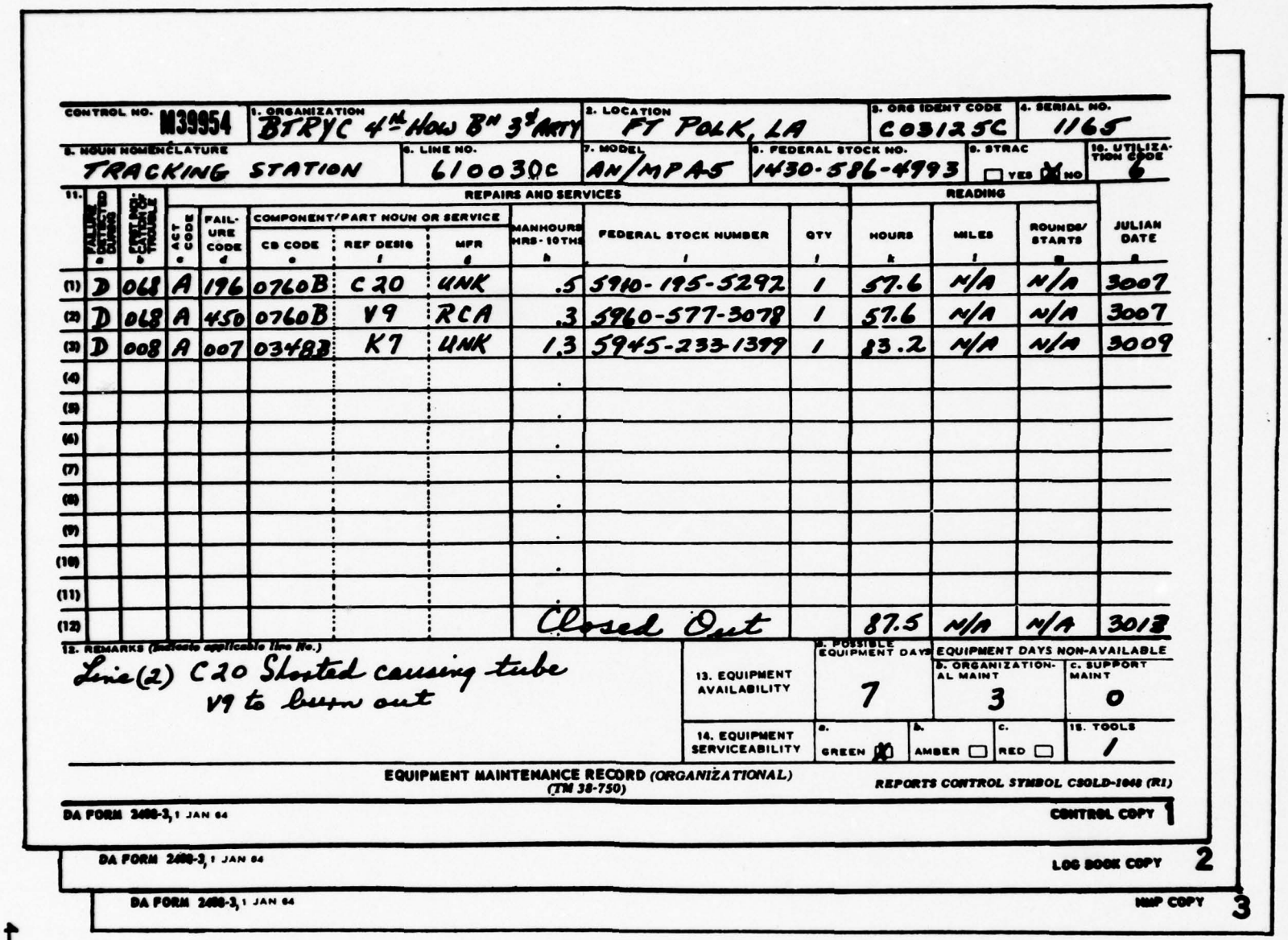
1

20. PARTS REPAIRED OR REPLACED DURING SHOP PROCESSING

FSC	PART NUMBER	WORK UNIT CODE	REF SYM	HOW MAL	QTY

DEPOT REPAIR CYCLE DATA

1. DATE REMOVED
2. RECEIVED IN BASE SUPPLY
3. SHIPPED TO SRA
4. RECEIVED AT SRA
5. ORDERED BY MAINTENANCE
6. RECEIVED IN MAINT. SHOP
7. MADE SERVICEABLE



CONTROL NO. M39954 | 1. ORGANIZATION: BTRY C 4th HOWBN 3d ARTY | 2. LOCATION: FT POLK, LA | 3. ORG IDENT CODE: C03125C | 4. SERIAL NO.: 1165

5. NOUN NOMENCLATURE: TRACKING STATION | 6. LINE NO.: 610030C | 7. MODEL: AN/MPA5 | 8. FEDERAL STOCK NO.: 1430-586-4993 | 9. STRAC: ☐ YES ☒ NO | 10. UTILIZATION CODE: C

11.	FAILURE DETECTED DURING	FAILING ITEM TROUBLE	REPAIRS AND SERVICES: ACT CODE	FAILURE CODE	COMPONENT/PART NOUN OR SERVICE: CB CODE	REF DESIG	MFR	MANHOURS HRS-10THS	FEDERAL STOCK NUMBER	QTY	READING: HOURS	MILES	ROUNDS/STARTS	JULIAN DATE
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
(1)	D	068	A	196	0760B	C20	UNK	.5	5940-195-5292	1	57.6	N/A	N/A	3007
(2)	D	068	A	450	0760B	V9	RCA	.3	5960-577-3078	1	57.6	N/A	N/A	3007
(3)	D	008	A	007	0348B	K7	UNK	1.3	5945-233-1399	1	83.2	N/A	N/A	3009
(4)														
(5)														
(6)														
(7)														
(8)														
(9)														
(10)														
(11)														
(12)								Closed Out			87.5	N/A	N/A	3013

12. REMARKS (Indicate applicable line No.)
Line (2) C20 Slotted causing tube V9 to burn out

13. EQUIPMENT AVAILABILITY | a. POSSIBLE EQUIPMENT DAYS: 7 | EQUIPMENT DAYS NON-AVAILABLE: b. ORGANIZATIONAL MAINT: 3 | c. SUPPORT MAINT: 0

14. EQUIPMENT SERVICEABILITY | a. GREEN ☒ | b. AMBER ☐ | c. RED ☐ | 15. TOOLS: 1

EQUIPMENT MAINTENANCE RECORD (ORGANIZATIONAL)
(TM 38-750)

REPORTS CONTROL SYMBOL CSGLD-1048 (R1)

DA FORM 2408-3, 1 JAN 64 — CONTROL COPY 1

DA FORM 2408-3, 1 JAN 64 — LOG BOOK COPY 2

DA FORM 2408-3, 1 JAN 64 — MMP COPY 3

Figure 4-7-3.

USE TYPEWRITER OR PRINT FIRMLY ON HARD SURFACE WITH HARD PENCIL OR BALL POINT PEN

MAINTENANCE REQUEST (TM 38-750)

Use reverse of this copy for notes and additional data.

PAGE NO. 1 | NO. OF PAGES 2 | REPORTS CONTROL SYMBOL CSGLD-1947 (R1)

SECTION I — ☐ WORK REQUEST ☐ MWO ☒ EIR ☐ 6 ORGANIZATION ISSUE PRIORITY DESIGNATOR CODE

1. CONTROL NUMBER	2A. ORGANIZATION	3. LOCATION	4. ORG IDENT CODE
F45448	Co A, 21st Avn Bn 21st Inf Div	APO 403, NY, NY	OA1234V

5. SERIAL NUMBER	5. NOUN NOMENCLATURE	6. LINE NUMBER	7. MODEL	8. FEDERAL STOCK NUMBER
51-1378	Helicopter	550020	OH-13E	1520-574-7950

9. STRAC	10. UTILIZATION CODE*	11. SELECTED ITEM	12. HOURS	13. MILES	14. ROUNDS	15. STARTS
☐ 1 YES ☒ 2 NO	ON	☐ 1 YES ☒ 2 NO	1508	N/A	N/A	N/A

16. FAILURE DETECTED DURING (Select one - use ✓ or X)
☐ A SCHED'D MAINTENANCE ☐ C TEST ☐ E STORAGE ☐ G FLIGHT
☐ B HANDLING ☒ D NORMAL OPERATION ☐ F INSPECTION ☐ H OTHER

17. FIRST INDICATION OF TROUBLE (Select one - use ✓ or X)
☒ 045 INOPERATIVE ☐ 046 OVERHEATING ☐ 796 OUT OF ADJUSTMENT
☐ 095 NOISY ☐ 047 LOW PERFORMANCE ☐ — OTHER

18. DESCRIBE DEFICIENCIES OR SYMPTOMS ON THE BASIS OF COMPLETE CHECKOUT AND DIAGNOSTIC PROCEDURE IN EQUIPMENT TM (Do not guess—Use reports)

SECTION II - WORK ACCOMPLISHED

19A. REPAIR ORGANIZATION/ACTIVITY	B. LOCATION	C. ORG/ACT IDENT CODE	20. TYPE ORGANIZATION/ACTIVITY ACCOMPLISHING WORK (Select one - use ✓ or X)	21. AMS ACT. CODE
			☐ 1 TOE ☐ 2 TD ☐ 3 CONTRACTOR	

22A. ACTION CODE	B. FAILURE CODE*	C. COMPONENT/PART NOUN, SERVICE, OR MWO NO. — C. CD CODE	C. REFERENCE DESIGNATOR	C. MFR. CODE	D. MANHOURS* (Hours & tenths)	E. FEDERAL STOCK NUMBER	F. PART SOURCE CODE	G. QUANTITY	H. PARTS COST
			I. TOTAL MANHOURS			J. TOTAL MANHOURS COST		K. TOTAL PARTS COST	

23. DELAY (Select one - use ✓ or X) ☐ 1 PARTS ☐ 2 MANPOWER ☐ 3 FACILITIES ☐ 4 FUNDS ☐ 5 TOOLS

24. ☐ DATA TRANSCRIBED TO LOG BOOK

25. SUBMITTED BY	26. RECEIVED BY	27. WORK STARTED BY	28. INSPECTED BY	29. ACCEPTED BY	30. DISPOSITION (Select one - Use ✓ or X)
JULIAN DATE 3056	JULIAN DATE	JULIAN DATE	JULIAN DATE	JULIAN DATE	☐ A TO USER ☐ B TO STOCK ☐ C SALVAGED ☐ D EVACUATED ☐ E CANNIBALIZATION

SECTION III - EQUIPMENT IMPROVEMENT RECOMMENDATION

32. NORMAL REPLACEMENT (Select one-use ✓ or X)	33. EIR (Select one - use ✓ or X)	34. RECOMMENDATION (Select one - use ✓ or X)	35A. ORGANIZATION/ACTIVITY	C. ORG/ACT IDENT CODE
☐ 1 YES ☐ 2 NO	☒ E EMERGENCY ☐ U URGENT ☐ R ROUTINE	☒ A IMPROVE DESIGN ☐ B MODIFY ☐ C REVISE PROCEDURE ☐ D OTHER (Specify)	HQ 21st Avn Bn, 21st Inf	IH1230V
			B. LOCATION: APO 403, NY, NY	d. SUBMITTED BY: Tom Shell

36. FEDERAL STOCK NUMBER	37. NOUN NOMENCLATURE	38. OPINION OR REMARKS. DESCRIBE CONDITIONS UNDER WHICH FAILURE OCCURRED. ATTACH PHOTOS OR SKETCHES, IF AVAILABLE.
1560-335-9832	Cable Assy	EIR confirming TWX AETTC 10341, 5 March 63.

1. Mfg part number - 47-120-168-1
2. Item serial number - None
3. TM number. 55-1520-204-50P, Page 2-288, Figure 98, Index 16.
4. Last overhaul - N/A
5. Quantity inspected - One

DA, FORM 2407, JAN 64 — REPLACES EDITION OF 1 APR 63, WHICH IS OBSOLETE. — MMP COPY 2

Figure 3-7.4-2.

USE TYPEWRITER OR PRINT FIRMLY ON HARD SURFACE WITH HARD PENCIL OR BALL POINT PEN

MAINTENANCE REQUEST - CONTINUATION SHEET (TM 38-750)	*See reverse of this copy for codes and additional data.	PAGE NO. 2	NO. OF PAGES 2	REPORTS CONTROL SYMBOL CSGLD-1067 (R1)

CONTROL NUMBER F45448 ☐ WORK REQUEST ☐ MWO ☒ EIR

SEQ. NO.	a. FAILURE* CODE	c. COMPONENT/PART NOUN, SERVICE, OR MWO NO. d. CD CODE	e. REFERENCE DESIGNATOR	f. MFR. CODE	g. MANHOURS* (Hours & Tenths)	h. FEDERAL STOCK NUMBER	i. PART NUMBER CODE	j. QUANTITY	k. PARTS COST
		6. Quantity Defective - 0							
		7. Time since new - 150 hrs							
		8. Since overhaul - N/A							
		9. Circumstances prior to difficulty - The weather was clear and warm, the pilot flying the aircraft at time of failure has 400 hours flying experience.							
		10. Description of difficulty - Preliminary investigation shows that upon executing a right climbing, nose low attitude, turn from a low altitude hover position the pilot experienced a sudden jerk of the cyclic stick to a right forward position. When an attempt was made to neutralize the controls, the cyclic stick jerked to an extreme left position and the main rotor blade struck the tail boom causing failure of the anti-torque system.							
		11. Cause - Failure of Cable Assembly (Main Rotor Hub).							
		12. Action Taken - There is one other aircraft on hand, with cable installed. This aircraft has been grounded pending completion of investigation of failure. There have been no previous failures of this component, there are no replacement stocks on hand. The defective cable has been removed and is being held as an EIR exhibit pending disposition instructions from the NMP. Photographs of the defective item are being processed and will be mailed under separate cover.							
		13. Recommendations - None at present, pending results of field investigation							

DA FORM 2407-1 JAN 65 REPLACES EDITION OF 1 APR 62, WHICH IS OBSOLETE. * NMP COPY

Figure 3-7.4-2—Continued.

MM-1021A

DIVISION Baltimore | DATE 5-15-64 | NUMBER MM-1024 | PAGE 17 OF 18

SHADED BLOCKS FOR CODING

.002PR	.008 PN	.010 IN	.016 C/SN	.018 MFR	.024 DOE	.025 EC	.0100	.0101	.0102
					.0103	.0104	.0106	.0106	

MARTIN COMPANY

MARS R 16507

1. TYPE REPORT ☐ REJECT ☐ REWORK ☐ MRBR ☐ OTHER

2. PROGRAM | MODEL | SERIES

3. MASTER ACCOUNT NO.

4. PURCHASE/WORK ORDER NO.

5. DATE OF OCCURRENCE | MO. | DAY | YEAR

6. ACCRUED OPERATING TIME | .1 TIME | .2 CYCLES

7. INITIAL REPORT NO.

8. ITEM PART NO.

9. ITEM S/N

10. ITEM NAME

17. SYM. DES.

18. MANUFACTURER

11. NEXT ASSEMBLY PART NO.

12. NEXT ASSY. S/N

13. NEXT ASSY. NAME

19. VEH/EQUIP. S/N

20. REPLCMT. REQ'D? .1 YES .2 NO

21. F.A. REQ'D? .1 YES .2 NO

14. COMPONENT/SYS PART NO.

15. COMP/SYS - S/N

16. COMP/SYS NAME

22.

23.

.1 ITEM	.2 TOTAL QTY	.3 QTY DEFECT	.4 TOTAL DEFECTS	.5 RESP	.6 SER	.7 COST	.8 CODE	.9 CODE	.10 CODE

24. DESCRIPTION OF EVENT (INDICATE ENVIRONMENT INCLUDING TYPE TEST/OPERATION)

25. CAUSE OF EVENT

26. CORRECTIVE ACTION TAKEN/REPLACING SERIAL NO.

27. REPORTED BY | .1 LOCATION CODE

28. SHOP SUPERVISOR | .1 DEPT. RESP.

29. FLOOR DISP. .1 MRB .2 RTV .3 SCRAP .4 RWK/REP. .5 UAI .6 ☐

30. QUALITY SUPERVISOR

31. ASSOC. CONTRACTOR/CUSTOMER

.1 ITEM	.2 QTY PARTS	.3 DISP	32. DISPOSITION INSTRUCTIONS .4

33. MRB DISPOSITION .1 REWORK .2 SCRAP .3 USE AS IS .4 RTV .5 DEVIATION

34. MRB QUALITY | .1 DATE

35. MRB ENGINEERING | .1 DATE

36. ASSOC CONTR REP & CO. | .1 DATE

37. CUSTOMER REP | .1 DATE

38. FINAL ACCEPTANCE STAMPS | .1 SHOP | .2 QUALITY | .3 CUSTOMER

39. TIME TO RESTORE TO OPERATIONAL STATUS

.1 DIAGNOSIS HR MIN ✓ | .2 OBT. REPL'T HR MIN ✓ | .3 REPL'T ACTION HR MIN ✓ | .4 CHECKOUT HR MIN ✓ | .5 TOTAL HR MIN ✓

TO BE REMOVED BY QUALITY ONLY R 16507

☐ REJECT ☐ REWORK ☐ MRB ☐ OTHER

MM-1024 (12-63)

MARTIN MARIETTA

DIVISION	DATE	NUMBER	PAGE OF
Baltimore	5-15-64	MM-1024	18 18

ATTACH SECURELY
TO FAILED ITEM

TO BE REMOVED BY
QUALITY CONTROL ONLY

40. DISCREPANCY/DEFECT VERIFICATION

41. CAUSE

42. F.A.R. NO

43. SIGNATURE

.1 DATE

44. PARTS REPLACED DURING REWORK/REPAIR

.1 QTY	.2 PART NAME	244 CODE	.3 PART NUMBER	.4 S/N	.5 SYM DES.	.6 MANUFACTURER	.7 REASON FOR REPLACEMENT	.8 MRB DISP

45. UNUSUAL CONDITIONS FOUND DURING REPAIR

46.	49. DATE REWORKED MONTH / DAY / YEAR	50.		53. QUALITY INSPECTOR ACCEPTING	55. ACCEPTANCE STAMP
47.	51. REWORKED BY		.1 DEPT	54. CUSTOMER ACCEPTANCE	
48.	52. SHOP SUPERVISOR		.1 DEPT	56. ATTACHMENTS .1 PHOTO .2 TEST REPORT .3 SKETCH .4 OTHER	

MM-1021A (4/63)

MARTIN MARIETTA

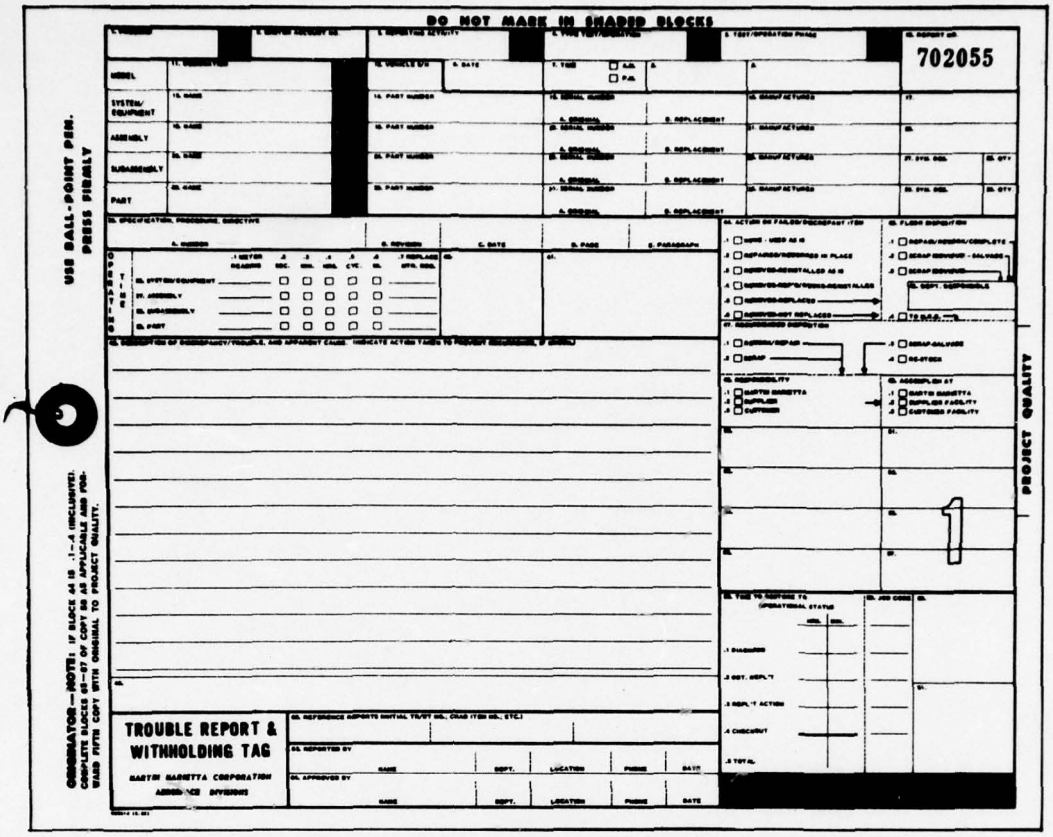


Figure 1. Trouble Report & Withholding Tag, Form 060414 (2-62)

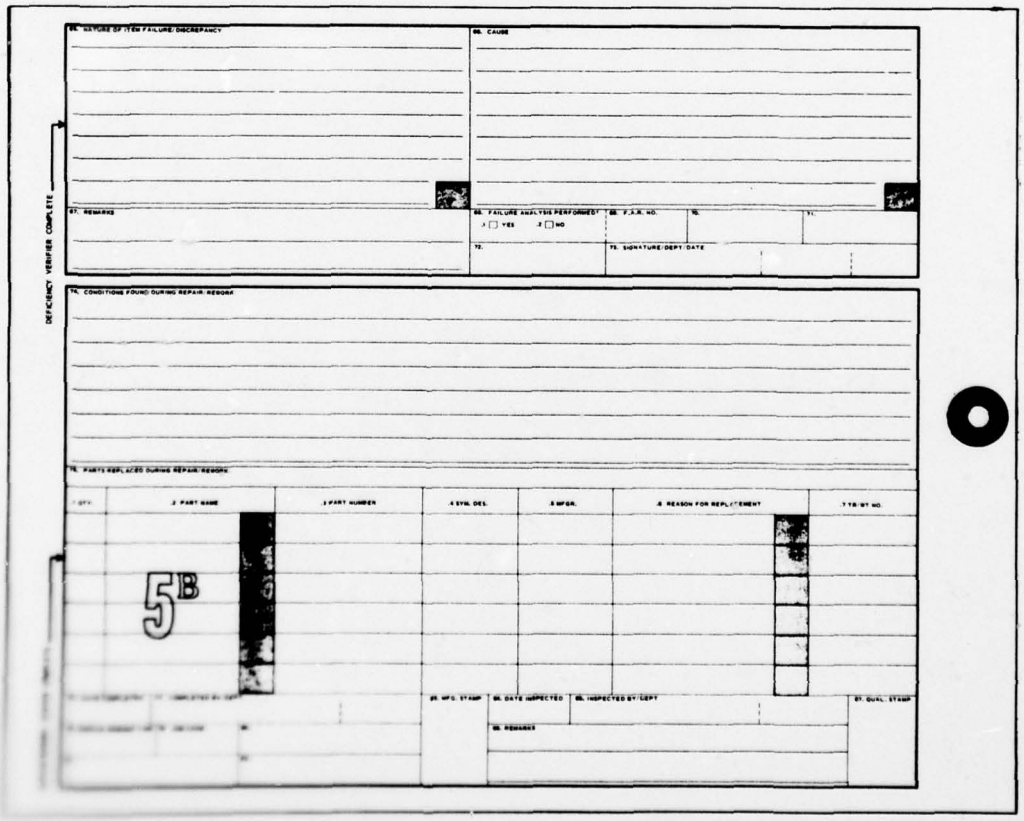


Figure 6. Trouble Report & Withholding Tag, Copy 5b (5-Back)

QUALITY RELIABILITY CONSUMPTION REPORT

MARTIN

DEN 044124 (4-61)

K 37251

02 SYS | COMP | LINE | 03 ASSY | 04 PART | 05 ITEM | 06 FAILURE CAUSE | 07 FAILURE CODE | 08 [illegible] | 09 TEST TYPE | 10 MANUFACTURER CODE | 11 FAILURE ANALYSIS REQUIRED 1 NO [ ] 2 YES [ ]

12 ITEM PART NUMBER | 13 | 14 ITEM SERIAL NUMBER | 15 [illegible] | 16 ITEM MATERIAL TYPE | 17 [illegible]

NOT TO BE COMPLETED BY OUTSIDE VENDOR OR RECEIVING INSPECTION

18 NEXT ASSEMBLY PART NUMBER | 19 | 20 NEXT ASSEMBLY SERIAL NO. | 21 MISSILE TYPE / MODEL / SERIES | 22 MISSILE FUSE / ITEM SERIAL NO. | 23 ITEM MATERIAL TYPE | 24 FAILURE DATE DAY | MONTH | YEAR

TO BE COMPLETED BY OUTSIDE VENDOR AND/OR RECEIVING INSPECTION ONLY

25 P.O. OR ORDER NUMBER | 26 RECEIVING REPORT NUMBER | 27 STOCK NUMBER | 28 MATERIAL CODE | 29 CONTRACT NUMBER

32 33 DESCRIPTION OF TROUBLE INCLUDING TYPE OF TEST MODE AND CONDITION OF FAILURE ENVIRONMENTS AND MEASUREMENTS

34 CAUSE OF DISCREPANCY | 35 CORRECTIVE ACTION | 36 1 GFAE 2 ASSOCIATE 3 CONTRACTOR | 37 [illegible] | 38 PART CHANGE

39 [illegible] | 40 STAMP | 41 NEW ITEM PART NO.

42 [illegible] STAMP

43 DISPOSITION INSTRUCTIONS | 44 MATERIAL REVIEW INSTR REQUIRED ☐ | 45 RTV ☐ | 46 SCRAP ☐ | 47 [illegible] DRAWING ☐ | 48 MRB ☐

49 QUALITY CONTROL SUPERVISOR

50 USE AS IS ☐ | 51 REPAIR ☐ | 52 REWORK ☐

53 QUALITY CONTROL MRB

54 ENGINEERING MRB

55 CUSTOMER MRB

56 ASSOCIATE CONTRACTOR OR CUSTOMER

Front Side - Shaded Blocks Not to be Used by Suppliers

57 K 37251 | 58 SYS | COMP | LINE | 59 LOCATION CODE

REWORK FOLLOW-UP COPY

	60 PART NUMBER	61 PART SER NO	62 PART NAME	63 PART MANUFACTURER	64 CIRCUIT SYMBOL	65 FAILURE CODE	66 MANUFACTURER CODE	67 INDEX
A								
B								
C								
D								
E								
F								
G								
H								

68 71 REPAIR/REWORK ACTION NECESSARY - UNUSUAL CONDITIONS DISCOVERED DURING REWORK

72 74 LAB TEST RESULTS

75 DATE REWORKED DAY | MONTH | YEAR

76 REWORKED BY | 77 DEPT

78 SHOP SUPERVISOR | 79 DEPT

80 QC INSPECTOR ACCEPTING | 81 ACCEPTANCE STAMP

82 ATTACHMENTS PHOTOS [1] TEST REPORTS [2] SKETCHES [3] OTHER [4]

83 CUSTOMER ACCEPTANCE OF REWORK/REPAIR (OPT)(GFAE)

REVERSE CARBONS BEFORE WRITING ON THIS SIDE

Reverse Side - Shaded Blocks Not to be Used by Suppliers

FAILURE REPORT

WESTERN BRANCH, PESCO PRODUCTS

1. REPORT NO. C585
2. DATE OF FAILURE
3. DEPT.
4. REPORTED BY

5. FAILED ITEM
NAME(S)
PART NO(S).
CIRCUIT DESIGNATION
MFR.

7. ASSEMBLY PART NO.

8. SERIAL NO.

9. FAILURE DISCOVERED DURING
☐ ENGINEERING
☐ PRODUCTION/TEST
☐ FIELD

ORIGINATOR

10. DESCRIPTION OF FAILURE

11. CLASSIFICATION OF FAILURE
☐ CATASTROPHIC
☐ DEGRADATION

12. HUMAN ERROR
☐ YES
☐ NO

13. FAILURE ANALYSIS AND CORRECTIVE ACTION INDICATED

Q.C. OR ENGR.

14. DISPOSITION

15. COMMENTS AND RECOMMENDATIONS

REL. ENGR.

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HONEYWELL INERTIAL GUIDANCE CENTER

FAILURE REPORT

REPORT NO. F 01030
DATE OF FAILURE _____
LOG CARD NO _____

1.0 IDENTIFICATION
1.1 System: NAME IDS NO.
1.2 Failed Part: Fill out in successive order of assemblies until the largest known unit that contains the failed part is recorded. Start with the smallest identifiable failed equipment or part(s).

Origin of failure report:
Rec. Insp. ☐ Evaluation ☐
Assembly ☐ Field Svc. ☐
Final Test ☐

	NAME	PART OR DEVICE NO.	SERIAL	SERIES	DWG. NO.	REF. DESIG. NUMBER	ASSEMBLY AND/OR SYSTEM ELAPSED TIME INDICATOR READING
Smallest failed parts							
Next largest assemblies							

2.0 IDENTIFICATION OF FAILURE (To fill in use code on reverse side of card.)

2.1 Environment	2.2 First indication of failure	2.3 Description of failure	2.4 Failure discovered during	2.5 Interconnection failure	2.6 Failure due to

3.0 DESCRIBE FAILURE

Tester Supervisor

RETURN TOP SHEET TO THE RELIABILITY GROUP WHEN ITEMS 1 THROUGH 3 ARE COMPLETED

4.0 REWORK REPORT Describe repair work. Parts replaced:

	MH NO.	NAME	VENDOR
1.			
2.			
3.			
4.			
5.			
6.			

Repaired by: Supervisor

5.0 UNIT RETESTED BY: PASSED: Yes No

6.0 AFTER ABOVE WORK, RETURN FORMS TO THE RELIABILITY GROUP

7.0 DESIGN ANALYSIS Is corrective action necessary Yes No Explain

Date Reviewed by: Designer Supervisor

8.0 RELIABILITY ANALYSIS

Number of times part or equipment has failed Reliability Engineer

ENG. 24.00-05 REV A

FIGURE 1-2A
FAILURE REPORT

PRECEDING PAGE BLANK - FILMED

GENERAL ELECTRIC
RE-ENTRY SYSTEMS DEPARTMENT
3198 Chestnut Street, Philadelphia, Pa. 19101

NCR NO. 25406

PLEASE PRINT
PRESS HARD

NONCONFORMANCE REPORT

AREA 1	PROGRAM 2	C. C. NO. 3	DWG./PART NO. 4	REV. 5	AM 6	NOMENCLATURE 7	SL./P.S. LOT 8

☐ MC ☐ IR

☐ VENDOR DISCREPANCY 9
☐ IN-HOUSE DISCREPANCY
☐ RELIABILITY DISCREPANCY

DATE 10	SHOP ORDER NO. 11	SI-GAP NO. 12	SI/GAP REV. 13	TYPE TEST 14	EQUIP. TYPE 15

QTY. REC'D 16	QTY. INS. 17	QTY. REJ. 18	VENDOR-SHOP NAME 19	S.C. SHOP 20	P.C. 21	SYS.-VEH. APP. 22

PUR. ORD. POWO NO. 23	P.O. AM 24	VEND. NO. 25	SCE. INSP. 26 ☐ GOVT. ☐ G.E. ☐ OTHER	REPORTED BY 27

SERIAL NO. 28	CLASS 29	ENV.-OPER. 30	DEF. CD 31	RESP. 32	DESCRIPTION OF NONCONFORMANCE 90

PRELIMINARY REVIEW
REVIEWED APPROVED BY

☐ REWORK TO DRAWING
☐ REWORK TO STD. REPAIR # _____
☐ RECOMMEND SCRAP 34
☐ REFER TO MRB

DISP. CODE 95

DISPOSITION/MATERIAL CORRECTION 36

INSP. 37 STAMP

SIGNATURE DATE

CORRECTIVE ACTION 38

SIGNATURE DATE

MRB DISPOSITION AUTHORITY/CONCURRENCE

DESIGN ENGINEER 39	QUALITY CONTROL & TEST 40	CUSTOMER REPRESENTATIVE 41
PRODUCTION CONTROL (AS REQ'D) 42	PURCHASING 43	OTHER

25406

REPLACEMENT SERIAL NO. 44	REPLACEMENT DRAWING NO. 45	NEXT HIGHER ASS'Y NAME 46	NEXT HIGHER ASS'Y DWG. NO. 47

FINAL DISPOSITION ACTION 48

☐ 1. ACCEPT AS IS ☐ 3. REWORK ☐ 5. SCRAP

☐ 2. RETURN TO VENDOR ☐ 4. CONTINUE TEST ☐ 6. OTHER

REPAIR – REWORK DATA

QTY 49	PART DWG. NO. 50	NOMENCLATURE 51	FAIL CODE 52	REF. DESIG./SYMBOL 53

REMARKS 54

UCI NO. 55	AN NO. 56	REPAIR TIME 57	DATE REC'D 58	DATE REPAIRED 59	FAILURE ANALYSIS NO. 60	
					1. YES	2. NO

FINAL DISPOSITION SIGNATURES

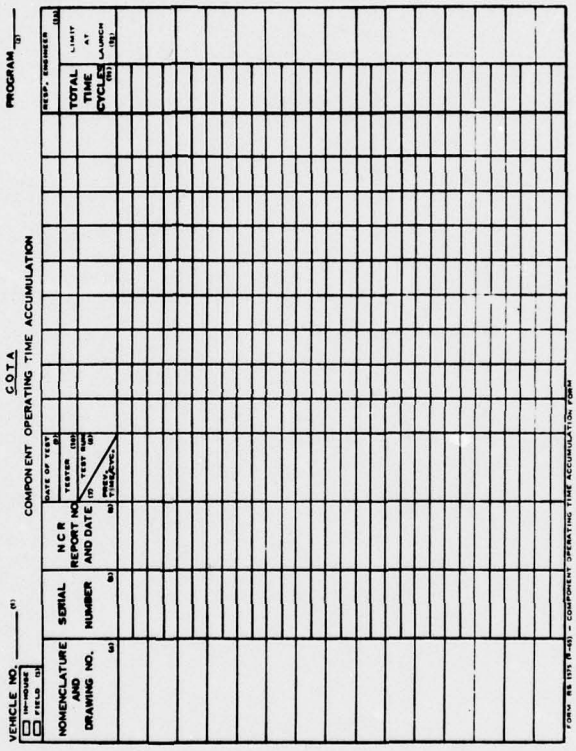
_____

_____

_____

REWORK ACCEPTANCE STAMP 62

SAMPLE COMPONENT OPERATING TIME ACCUMULATION (FORM RS1575)



APPENDIX G

SUMMARY DESCRIPTIONS OF VARIOUS DATA-REPORTING SYSTEMS

APPENDIX F

SUMMARY DESCRIPTIONS OF VARIOUS DATA-REPORTING SYSTEMS

1. Standard Navy Maintenance and Material Management System (3M)

The 3M System provides for the administration of Fleet maintenance in an orderly manner, and for the compilation of failure data and other data related to the costs of maintenance. The system produces a large reservoir of knowledge about equipment problems and their attendant maintenance demands, which, when fed back to the appropriate sources, should result in corrective steps to prevent recurrences. 3M System is complemented by the Maintenance Data Collection System (MDCS), which is the control-and-information system for gathering the necessary maintenance data.

2. Operational Test and Evaluation Force (OPTEVFOR)

OPTEVFOR is primarily concerned with the latter part of the research and development phase and with the test and evaluation phase in the life cycle of Naval equipment. OPTEVFOR influences procurement decisions by furnishing CNO with factual information on the operational performance and material suitability of new equipment. It aids other operational commands by providing quantitative performance and tactical information.

3. Failure Rate Data Program (FARADA)

The FARADA Program is directed by the Systems Engineering Command and implemented by the U. S. Naval Fleet Missile Systems Analysis and Evaluation Group (FMSAEG) at Corona, California. The program is sponsored by the Navy, Air Force, Army, and NASA to provide failure-rate data on parts and components to prime contractors and major subcontractors engaged in the design, development, and production of hardware for the entire spectrum of military and space equipments.

4. Automatic Reliability and Maintainability Measuring System (ARMMS)

The Individual Record of Corrective Action (IRCA) used in ARMMS provides a time breakdown by function of all unscheduled maintenance actions. The form provides records of the time required to perform tasks that are integral parts of the maintenance actions -- set-up, verify malfunction, isolate fault, remove/disassemble, repair, install, etc.

5. University of Pennsylvania's Monitor Data System (MDS)

The inputs to the University of Pennsylvania's MDS are detailed characteristics of electrical and electromechanical assemblies in Navy equipments; the system stores this information so that is is easily retrievable by a broad class of users.

To facilitate searching, selected general and electrical characteristics of each assembly are committed to magnetic-tape memory. The selected information identifies the pertinent documentation and provides an abstract of the salient characteristics of the assembly.

6. Casualty Report (CASREP)

The CASREP is a report forwarded in the form of a standard Navy radio dispatch to indicate a "casualty" or equipment malfunction. The report includes the minimum pertinent information, such as equipment designation, cause of malfunction, estimated time to repair, and identification of failed unit or part.

7. Maintenance Engineering Analysis Records (MEARS)

MEARS forms are prepared by the manufacturer to document an integrated maintainability and support program for weapons, weapons systems, and related equipments being procured under a specific contract. The MEARS forms document maintenance concepts, identify maintenance resources, determine personnel and training requirements, provide information for technical manuals, determine support-equipment requirements, and provide the basis of progress and status reporting for support requirements.

8. Reporting Forms Used by BuShips

The following reporting forms have been used by BuShips but are now being phased out:

(1) Failure/Replacement Report DD-787 (BUSHIPS 10550-1)

(2) Electronic Equipment Operational Time Log (NAVSHIPS 4855)

(3) Electronics Performance and Operational Reports (NAVSHIPS 3878)

(4) Report of Equipment Failure (NAVSHIPS 3621)

These reports provide feedback information to establish severity levels for each maintenance problem area, provide equipment performance data for use in engineering analyses, and form the bases of recommendations for specific corrective actions. All the forms are used to establish accurate measures of equipment reliability under actual field conditions.

9. Failure, Unsatisfactory, or Removal Report (NAVWEPS FORM 13070/3)

The FUR collects specific information considered essential to conduct complete evaluations and analyses of problem areas associated with Naval aeronautical weapons systems. The form is used to report all unscheduled maintenance actions, failures, deficiencies, or malfunctions of aeronautical material associated with certain types of aircraft and permits grouping of defects and failures by functional system and parts.

10. The SAM Fleet Reporting System

The SAM Fleet reporting system is an integrated program of reliability, operability, part failure-data collection, and data processing and analysis for surface missile systems. The system provides improved failure and availability data, and a method for "local" assessment of complex weapons systems.

11. AFM 66-1

The Air Force Maintenance Data Collection System, documented in AFM 66-1, was designed for management of maintenance resources; it supplies data to management at the Base level within the Chief of Maintenance complex, intermediate and major command Headquarters, and to the Air Force Logistics Command. Maintenance data-collection forms (AFTO 210, 211, and 212) are designed to serve as source documents for the Maintenance Data Collection System. These forms are utilized to record production credit, and narrative and coded information on discrepancies and maintenance actions for all tasks requiring expenditure of direct labor by maintenance personnel.

12. U. S. Army Equipment Record Procedures (DA Forms 2407 and 2408-3)

Army Equipment Record Procedures are based on the concept of recording essential data concerning equipment operation and maintenance during the equipments life cycle in the Army inventory. This essential information is collected (on forms 2407 and 2408-3), processed, and analyzed to facilitate management of the maintenance effort and to cross-feed information to all sections of the command whose activities may be influenced by these data.

13. Manufacturers' Reporting Systems (Summary)

The systematic data-collection and-recording systems established by manufacturers provide continuous inputs in support of reliability and maintainability evaluations of weapons systems during their various phases of research and development, testing, and operation. Reliability data from field service organizations is machine processed and constantly reevaluated in order for the manufacturer to make engineering recommendations for changes based on equipment performance in its final environment.